

# DATA SHEET

## **TDA2616/TDA2616Q** 2 x 12 W hi-fi audio power amplifiers with mute

Product specification  
File under Integrated Circuits, IC01

July 1994

## 2 x 12 W hi-fi audio power amplifiers with mute

## TDA2616/TDA2616Q

### FEATURES

- Requires very few external components
- No switch-on/switch-off clicks
- Input mute during switch-on and switch-off
- Low offset voltage between output and ground
- Excellent gain balance of both amplifiers
- Hi-fi in accordance with IEC 268 and DIN 45500
- Short-circuit proof and thermal protected
- Mute possibility.

### GENERAL DESCRIPTION

The TDA2616 and TDA2616Q are dual power amplifiers. The TDA2616 is supplied in a 9-lead single-in-line (SIL9) plastic power package (SOT131), while the TDA2616Q is supplied in a 9-lead SIL-bent-to-DIL plastic power package (SOT157). They have been especially designed for mains fed applications, such as stereo radio and stereo TV.

### QUICK REFERENCE DATA

Stereo application

| SYMBOL    | PARAMETER                       | CONDITIONS                   | MIN. | TYP. | MAX. | UNIT    |
|-----------|---------------------------------|------------------------------|------|------|------|---------|
| $\pm V_P$ | supply voltage range            |                              | 7.5  | –    | 21   | V       |
| $P_O$     | output power                    | $V_P = \pm 16$ V; THD = 0.5% | –    | 12   | –    | W       |
| $G_V$     | internal voltage gain           |                              | –    | 30   | –    | dB      |
| $ G_V $   | channel unbalance               |                              | –    | 0.2  | –    | dB      |
| $\alpha$  | channel separation              |                              | –    | 70   | –    | dB      |
| SVRR      | supply voltage ripple rejection |                              | –    | 60   | –    | dB      |
| $V_{no}$  | noise output voltage            |                              | –    | 70   | –    | $\mu$ V |

### ORDERING INFORMATION

| EXTENDED TYPE NUMBER | PACKAGE |                 |          |                       |
|----------------------|---------|-----------------|----------|-----------------------|
|                      | PINS    | PIN POSITION    | MATERIAL | CODE                  |
| TDA2616              | 9       | SIL             | plastic  | SOT131 <sup>(1)</sup> |
| TDA2616Q             | 9       | SIL-bent-to-DIL | plastic  | SOT157 <sup>(2)</sup> |

### Notes

1. SOT131-2; 1996 August 27.
2. SOT157-2; 1996 August 27.

2 x 12 W hi-fi audio power amplifiers with mute

TDA2616/TDA2616Q

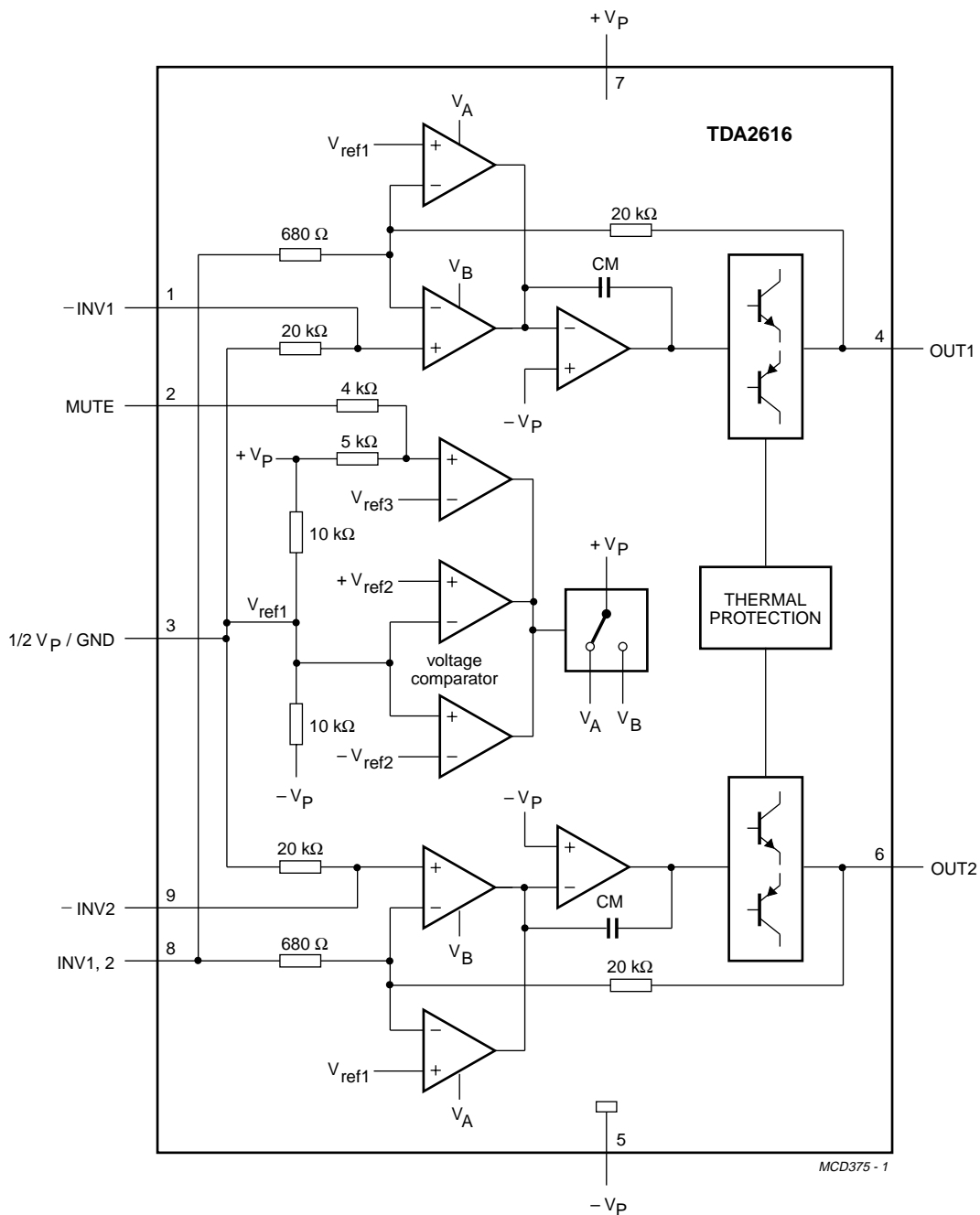


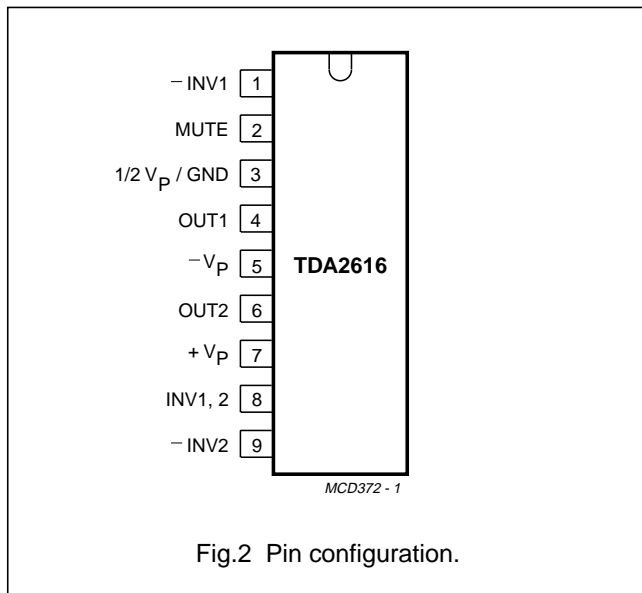
Fig.1 Block diagram.

## 2 x 12 W hi-fi audio power amplifiers with mute

## TDA2616/TDA2616Q

### PINNING

| SYMBOL                 | PIN | DESCRIPTION                  |
|------------------------|-----|------------------------------|
| -INV1                  | 1   | non-inverting input 1        |
| MUTE                   | 2   | mute input                   |
| 1/2V <sub>P</sub> /GND | 3   | 1/2 supply voltage or ground |
| OUT1                   | 4   | output 1                     |
| -V <sub>P</sub>        | 5   | supply voltage (negative)    |
| OUT2                   | 6   | output 2                     |
| +V <sub>P</sub>        | 7   | supply voltage (positive)    |
| INV1, 2                | 8   | inverting inputs 1 and 2     |
| -INV2                  | 9   | non-inverting input 2        |



### FUNCTIONAL DESCRIPTION

The TDA2616 is a hi-fi stereo amplifier designed for mains fed applications, such as stereo radio and TV. The circuit is optimally designed for symmetrical power supplies, but is also well-suited to asymmetrical power supply systems.

An output power of  $2 \times 12$  W (THD = 0.5%) can be delivered into an  $8 \Omega$  load with a symmetrical power supply of  $\pm 16$  V. The gain is internally fixed at 30 dB, thus offering a low gain spread and a very good gain balance between the two amplifiers (0.2 dB).

A special feature is the input mute circuit. This circuit disconnects the non-inverting inputs when the supply voltage drops below  $\pm 6$  V, while the amplifier still retains its DC operating adjustment. The circuit features suppression of unwanted signals at the inputs, during switch-on and switch-off.

The mute circuit can also be activated via pin 2. When a current of  $300 \mu\text{A}$  is present at pin 2, the circuit is in the mute condition.

The device is provided with two thermal protection circuits. One circuit measures the average temperature of the crystal and the other measures the momentary temperature of the power transistors. These control circuits attack at temperatures in excess of  $+150^\circ\text{C}$ , so a crystal operating temperature of max.  $+150^\circ\text{C}$  can be used without extra distortion.

With the derating value of  $2.5 \text{ K/W}$ , the heatsink can be calculated as follows:

at  $R_L = 8 \Omega$  and  $V_P = \pm 16$  V, the measured maximum dissipation is  $14.6 \text{ W}$ .

With a maximum ambient temperature of  $+65^\circ\text{C}$ , the thermal resistance of the heatsink is:

$$R_{\text{th}} = \frac{150 - 65}{14.6} - 2.5 = 3.3 \text{ K/W.}$$

The internal metal block has the same potential as pin 5.

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### LIMITING VALUES

In accordance with the Absolute maximum System (IEC 134).

| SYMBOL     | PARAMETER                           | CONDITIONS                      | MIN. | MAX. | UNIT |
|------------|-------------------------------------|---------------------------------|------|------|------|
| $\pm V_P$  | supply voltage                      |                                 | –    | 21   | V    |
| $I_{OSM}$  | non-repetitive peak output current  |                                 | –    | 4    | A    |
| $P_{tot}$  | total power dissipation             | see Fig.3                       | –    | 25   | W    |
| $T_{stg}$  | storage temperature range           |                                 | –55  | +150 | °C   |
| $T_{XTAL}$ | crystal temperature                 |                                 | –    | +150 | °C   |
| $T_{amb}$  | ambient operating temperature range |                                 | –25  | 150  | °C   |
| $t_{sc}$   | short circuit time                  | short-circuit to ground; note 1 | –    | 1    | h    |

### Note to the limiting values

- For asymmetrical power supplies (with the load short-circuited), the maximum unloaded supply voltage is limited to  $V_P = 28\text{ V}$  and with an internal supply resistance of  $R_S \geq 4\ \Omega$ , the maximum unloaded supply voltage is limited to 32 V (with the load short-circuited). For symmetrical power supplies the circuit is short-circuit-proof up to  $V_P = \pm 21\text{ V}$ .

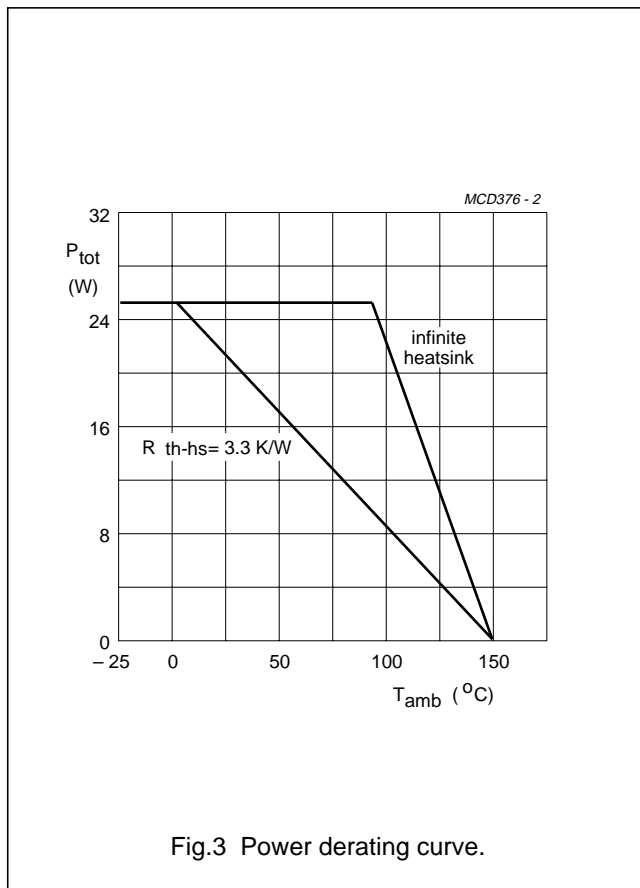


Fig.3 Power derating curve.

### THERMAL RESISTANCE

| SYMBOL        | PARAMETER                            | THERMAL RESISTANCE |
|---------------|--------------------------------------|--------------------|
| $R_{th\ j-a}$ | from junction to ambient in free air | 2.5 K/W            |

## 2 x 12 W hi-fi audio power amplifiers with mute

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### CHARACTERISTICS

| SYMBOL  | PARAMETER   | CONDITIONS              | MIN.     | TYP.            | MAX.   | UNIT       |
|---|---|-------------------------|----------|-----------------|--------|------------|
| <b>Supply</b>   |   |                         |          |                 |        |            |
| $\pm V_P$   | supply voltage range                              |                         | –        | 16              | 21     | V          |
| $I_{ORM}$   | repetitive peak output current                    |                         | –        | 2.2             | –      | A          |
| <b>Operating position; note 1</b>                             |   |                         |          |                 |        |            |
| $\pm V_P$   | supply voltage range                              |                         | 7.5      | 16              | 21     | V          |
| $I_P$   | total quiescent current                           | $R_L = \infty$          | 18       | 40              | 70     | mA         |
| $P_O$   | output power                                      | THD = 0.5%<br>THD = 10% | 10<br>12 | 12<br>15        | –<br>– | W<br>W     |
| THD   | total harmonic distortion                         | $P_O = 6$ W             | –        | 0.15            | 0.2    | %          |
| B   | power bandwidth                                   | THD = 0.5%; note 2      | –        | 20 to<br>20 000 | –      | Hz         |
| $G_V$   | voltage gain                                      |                         | 29       | 30              | 31     | dB         |
| $ G_V $   | gain unbalance                                    |                         | –        | 0.2             | 1      | dB         |
| $V_{no}$  | noise output voltage                              | note 3                  | –        | 70              | 140    | $\mu$ V    |
| $ Z_i $   | input impedance                                   |                         | 14       | 20              | 26     | k $\Omega$ |
| SVRR  | supply voltage ripple rejection                   | note 4                  | 40       | 60              | –      | dB         |
| $\alpha$  | channel separation                                | $R_S = 0$               | 46       | 70              | –      | dB         |
| $I_{bias}$  | input bias current                                |                         | –        | 0.3             | –      | $\mu$ A    |
| $ \Delta V_{GND} $  | DC output offset voltage                          |                         | –        | 30              | 200    | mV         |
| $ \Delta V_{4-6} $  | DC output offset voltage                          | between two channels    | –        | 4               | 150    | mV         |
| <b>MUTE POSITION (AT <math>I_{MUTE} \geq 300 \mu</math>A)</b> |   |                         |          |                 |        |            |
| $V_O$   | output voltage                                    | $V_I = 600$ mV          | –        | 0.3             | 1.0    | mV         |
| $Z_{2-7}$   | mute input impedance                              | note 7                  | 6.7      | 9               | 11.3   | k $\Omega$ |
| $I_P$   | total quiescent current                           | $R_L = \infty$          | 18       | 40              | 70     | mA         |
| $V_{no}$  | noise output voltage                              | note 3                  | –        | 70              | 140    | $\mu$ V    |
| SVRR  | supply voltage ripple rejection                   | note 4                  | 40       | 55              | –      | dB         |
| $ \Delta V_{GND} $  | DC output offset voltage                          |                         | –        | 40              | 200    | mV         |
| $ \Delta V_{off} $  | offset voltage with respect to operating position |                         | –        | 4               | 150    | mV         |
| $I_2$   | current if pin 2 is connected to pin 5            |                         | –        | –               | 8.2    | mA         |
| <b>Mute position; note 5</b>                                  |   |                         |          |                 |        |            |
| $\pm V_P$   | supply voltage range                              |                         | 2        | –               | 5.8    | V          |
| $I_P$   | total quiescent current                           | $R_L = \infty$          | 9        | 30              | 40     | mA         |
| $V_O$   | output voltage                                    | $V_I = 600$ mV          | –        | 0.3             | 1.0    | mV         |
| $V_{no}$  | noise output voltage                              | note 3                  | –        | 70              | 140    | $\mu$ V    |
| SVRR  | supply voltage ripple rejection                   | note 4                  | 40       | 55              | –      | dB         |

## 2 x 12 W hi-fi audio power amplifiers with mute

## TDA2616/TDA2616Q

| SYMBOL   | PARAMETER   | CONDITIONS                            | MIN. | TYP.            | MAX. | UNIT             |
|--|---|---------------------------------------|------|-----------------|------|------------------|
| $ \Delta V_{\text{GND}} $  | DC output offset voltage                          |                                       | –    | 40              | 200  | mV               |
| <b>Operating position; note 6</b>  |   |                                       |      |                 |      |                  |
| $I_{\text{P}}$   | total quiescent current                           |                                       | 18   | 40              | 70   | mA               |
| $P_{\text{O}}$   | output power                                      | THD = 0.5%                            | 5    | 6               | –    | W                |
|  |   | THD = 10%                             | 6.5  | 8               | –    | W                |
|  |   | THD = 0.5%; $R_{\text{L}} = 4 \Omega$ | –    | 10              | –    | W                |
|  |   | THD = 10%; $R_{\text{L}} = 4 \Omega$  | –    | 14              | –    | W                |
| THD  | total harmonic distortion                         | $P_{\text{O}} = 4 \text{ W}$          | –    | 0.13            | 0.2  | %                |
| B  | power bandwidth                                   | THD = 0.5%; note 2                    | –    | 40 to<br>20 000 | –    | Hz               |
| $G_{\text{V}}$   | voltage gain                                      |                                       | 29   | 30              | 31   | dB               |
| $ G_{\text{V}} $   | gain unbalance                                    |                                       | –    | 0.2             | 1    | dB               |
| $V_{\text{no}}$  | noise output voltage                              | note 3                                | –    | 70              | 140  | $\mu\text{V}$    |
| $ Z_{\text{i}} $   | input impedance                                   |                                       | 14   | 20              | 26   | $\text{k}\Omega$ |
| SVRR   | supply voltage ripple rejection                   |                                       | 35   | 44              | –    | dB               |
| $\alpha$   | channel separation                                |                                       | –    | 45              | –    | dB               |
| <b>MUTE POSITION (<math>I_{\text{MUTE}} \geq 300 \mu\text{A}</math>)</b> |   |                                       |      |                 |      |                  |
| $V_{\text{O}}$   | output voltage                                    | $V_{\text{I}} = 600 \text{ mV}$       | –    | 0.3             | 1.0  | mV               |
| $Z_{2-7}$  | mute input impedance                              | note 7                                | 6.7  | 9               | 11.3 | $\text{k}\Omega$ |
| $I_{\text{P}}$   | total quiescent current                           |                                       | 18   | 40              | 70   | mA               |
| $V_{\text{no}}$  | noise output voltage                              | note 3                                | –    | 70              | 140  | $\mu\text{V}$    |
| SVRR   | supply voltage ripple rejection                   | note 4                                | 35   | 44              | –    | dB               |
| $ \Delta V_{\text{off}} $  | offset voltage with respect to operating position |                                       | –    | 4               | 150  | mV               |
| $I_2$  | current if pin 2 is connected to pin 5            |                                       | –    | –               | 8.2  | mA               |

### Notes to the characteristics

- $V_{\text{P}} = \pm 16 \text{ V}$ ;  $R_{\text{L}} = 8 \Omega$ ;  $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ ;  $f = 1 \text{ kHz}$ ; symmetrical power supply  $I_{\text{MUTE}} < 30 \mu\text{A}$ . See Fig.4
- The power bandwidth is measured at an output power of  $P_{\text{O max}} - 3 \text{ dB}$
- The noise output voltage (RMS value) is measured at  $R_{\text{S}} = 2 \text{ k}\Omega$ , unweighted (20 Hz to 20 kHz)
- The ripple rejection is measured at  $R_{\text{S}} = 0$  and  $f = 100 \text{ Hz}$  to 20 kHz. The ripple voltage (200 mV) is applied in phase to the positive and the negative supply rails. With asymmetrical power supplies, the ripple rejection is measured at  $f = 1 \text{ kHz}$
- $\pm V_{\text{P}} = 4 \text{ V}$ ;  $R_{\text{L}} = 8 \Omega$ ;  $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ ;  $f = 1 \text{ kHz}$ ; symmetrical power supply. See Fig.4
- $V_{\text{P}} = 24 \text{ V}$ ;  $R_{\text{L}} = 8 \Omega$ ;  $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ ;  $f = 1 \text{ kHz}$ ; asymmetrical power supply  $I_{\text{MUTE}} < 30 \mu\text{A}$ . See Fig.5
- The internal network at pin 2 is a resistor divider of typical 4 k $\Omega$  and 5 k $\Omega$  to the positive supply rail. At the connection of the 4 k $\Omega$  and 5 k $\Omega$  resistor a zener diode of typical 6.6 V is also connected to the positive supply rail. The spread of the zener voltage is 6.1 to 7.1 V.

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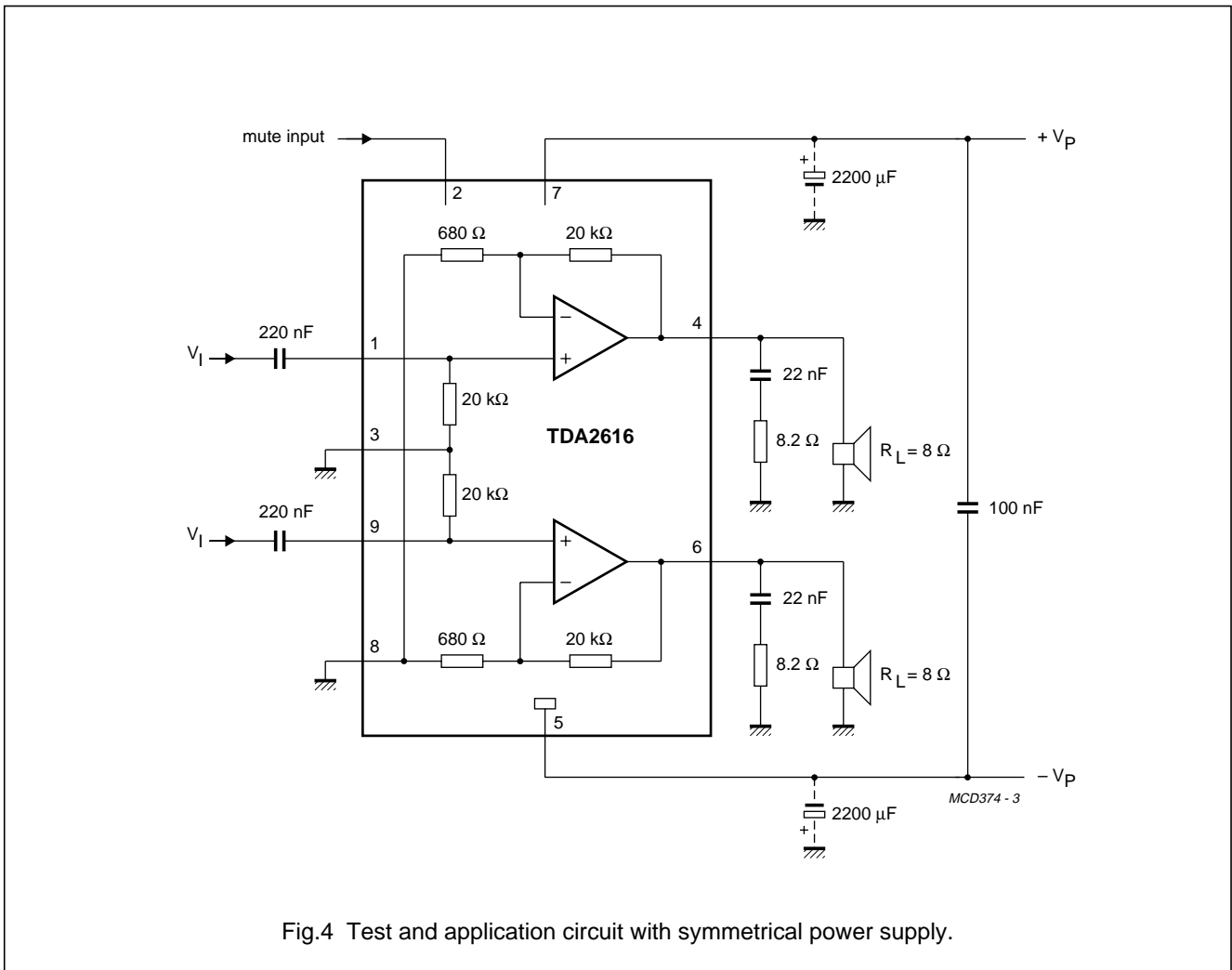


Fig.4 Test and application circuit with symmetrical power supply.

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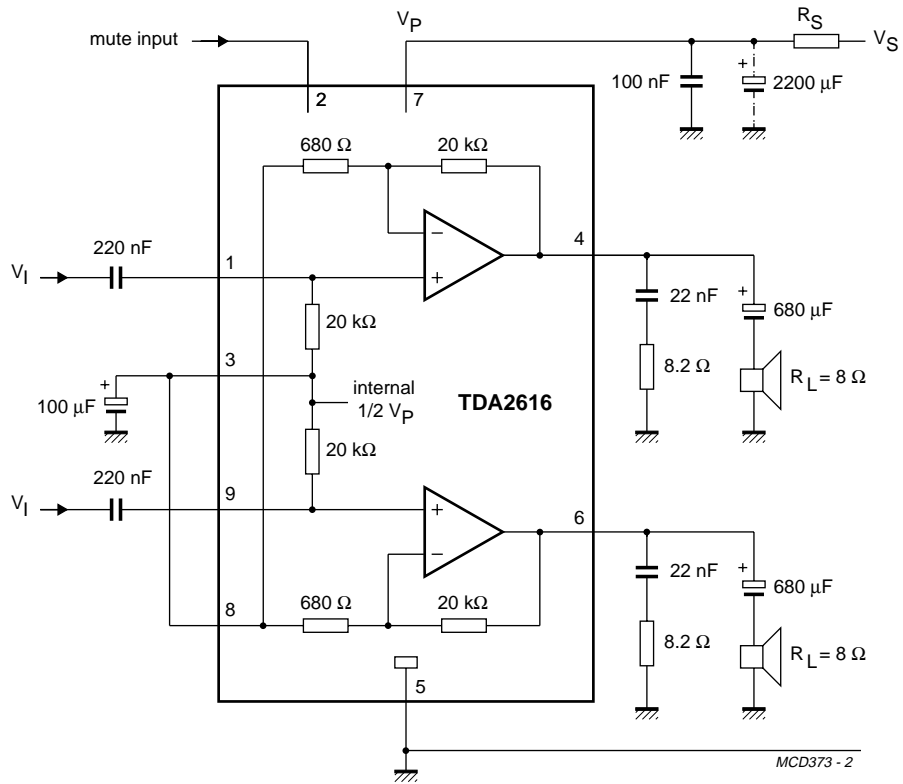


Fig.5 Test and application circuit with asymmetrical power supply.

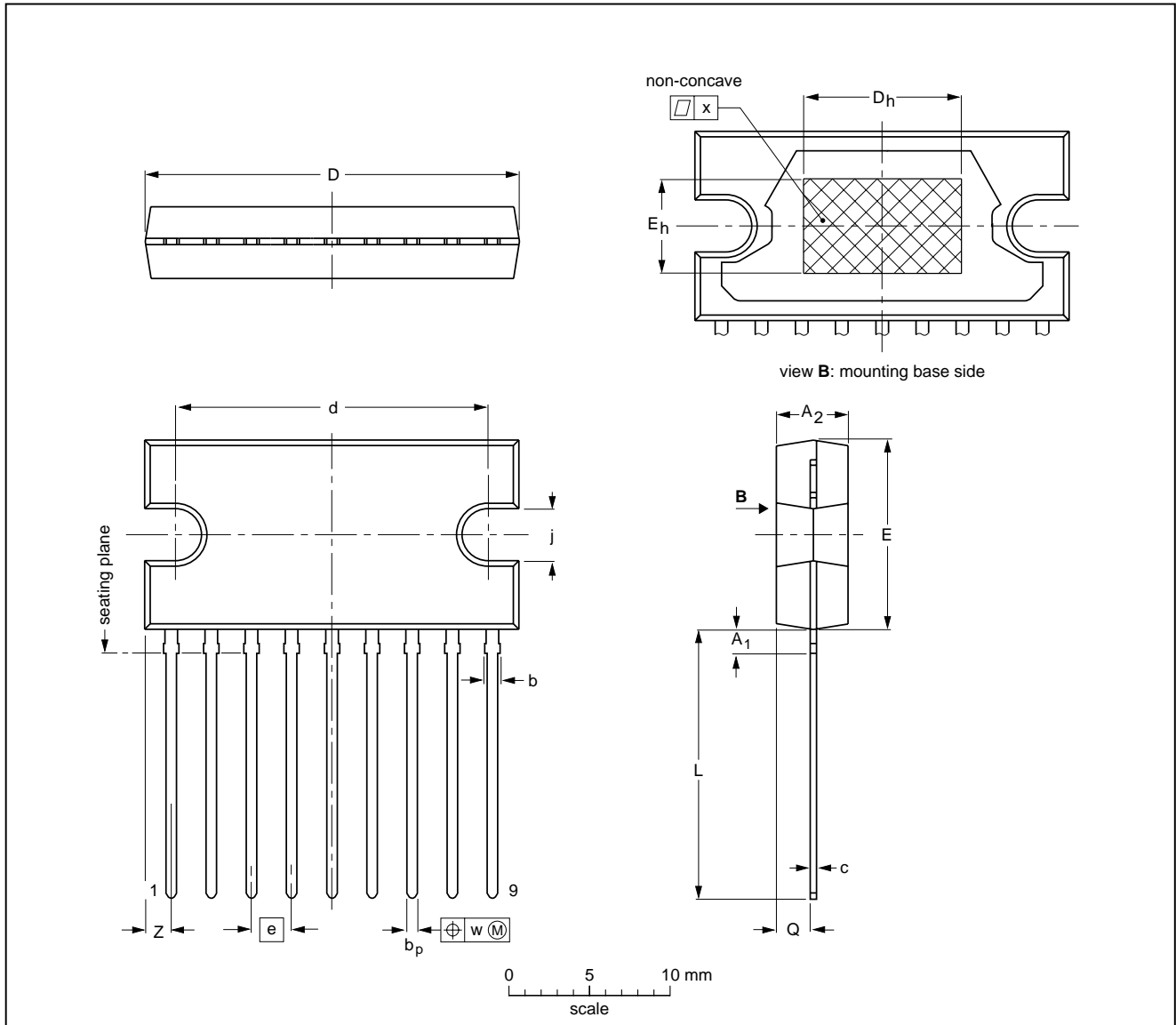
# 2 x 12 W hi-fi audio power amplifiers with mute

## TDA2616/TDA2616Q

### PACKAGE OUTLINES

SIL9P: plastic single in-line power package; 9 leads

SOT131-2



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

| UNIT | A <sub>1</sub><br>max. | A <sub>2</sub> | b<br>max. | b <sub>p</sub> | c            | D <sup>(1)</sup> | d            | D <sub>h</sub> | E <sup>(1)</sup> | e    | E <sub>h</sub> | j          | L            | Q          | w    | x    | z <sup>(1)</sup> |
|------|------------------------|----------------|-----------|----------------|--------------|------------------|--------------|----------------|------------------|------|----------------|------------|--------------|------------|------|------|------------------|
| mm   | 2.0                    | 4.6<br>4.2     | 1.1       | 0.75<br>0.60   | 0.48<br>0.38 | 24.0<br>23.6     | 20.0<br>19.6 | 10             | 12.2<br>11.8     | 2.54 | 6              | 3.4<br>3.1 | 17.2<br>16.5 | 2.1<br>1.8 | 0.25 | 0.03 | 2.00<br>1.45     |

**Note**

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

| OUTLINE VERSION | REFERENCES |       |      |  | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|-------|------|--|---------------------|----------------------|
|                 | IEC        | JEDEC | EIAJ |  |                     |                      |
| SOT131-2        |            |       |      |  |                     | 92-11-17<br>95-03-11 |

2 x 12 W hi-fi audio power amplifiers with mute

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DBS9P: plastic DIL-bent-SIL power package; 9 leads (lead length 12 mm)

SOT157-2

