

# DATA SHEET

## **TDA8563Q**

**2 × 40 W/2 Ω stereo BTL car radio  
power amplifier with diagnostic  
facility**

Product specification  
Supersedes data of 1996 Jan 08  
File under Integrated Circuits, IC01

2001 Feb 21

## 2 × 40 W/2 Ω stereo BTL car radio power amplifier with diagnostic facility

## TDA8563Q

### FEATURES

- Requires very few external components
- High output power
- 4 Ω and 2 Ω load impedance
- Low output offset voltage
- Fixed gain
- Diagnostic facility (distortion, short-circuit and temperature detection)
- Good ripple rejection
- Mode select switch (operating, mute and standby)
- Load dump protection
- Short-circuit safe to ground, to  $V_P$  and across the load
- Low power dissipation in any short-circuit condition

- Thermally protected
- Reverse polarity safe
- Electrostatic discharge protection
- No switch-on/switch-off plop
- Flexible leads
- Low thermal resistance.

### GENERAL DESCRIPTION

The TDA8563Q is an integrated class-B output amplifier in a 13-lead single-in-line (SIL) power package. It contains 2 × 40 W/2 Ω amplifiers in a BTL configuration.

The device is primarily developed for car radio applications.

### QUICK REFERENCE DATA

| SYMBOL        | PARAMETER                       | CONDITIONS                    | MIN. | TYP. | MAX. | UNIT |
|---------------|---------------------------------|-------------------------------|------|------|------|------|
| $V_P$         | operating supply voltage        |                               | 6.0  | 14.4 | 18   | V    |
| $I_{ORM}$     | repetitive peak output current  |                               | –    | –    | 7.5  | A    |
| $I_{q(tot)}$  | total quiescent current         |                               | –    | 115  | –    | mA   |
| $I_{stb}$     | standby current                 |                               | –    | 0.1  | 10   | μA   |
| $I_{sw}$      | switch-on current               |                               | –    | –    | 40   | μA   |
| $ Z_i $       | input impedance                 |                               | 25   | 30   | –    | kΩ   |
| $P_o$         | output power                    | $R_L = 4\ \Omega$ ; THD = 10% | –    | 25   | –    | W    |
|               |                                 | $R_L = 2\ \Omega$ ; THD = 10% | –    | 40   | –    | W    |
| SVRR          | supply voltage ripple rejection | $R_s = 0\ \Omega$             | –    | 60   | –    | dB   |
| $\alpha_{CS}$ | channel separation              | $R_s = 10\ k\Omega$           | –    | 50   | –    | dB   |
| $G_v$         | closed loop voltage gain        |                               | 25   | 26   | 27   | dB   |
| $V_{n(o)}$    | noise output voltage            | $R_s = 0\ \Omega$             | –    | –    | 120  | μV   |

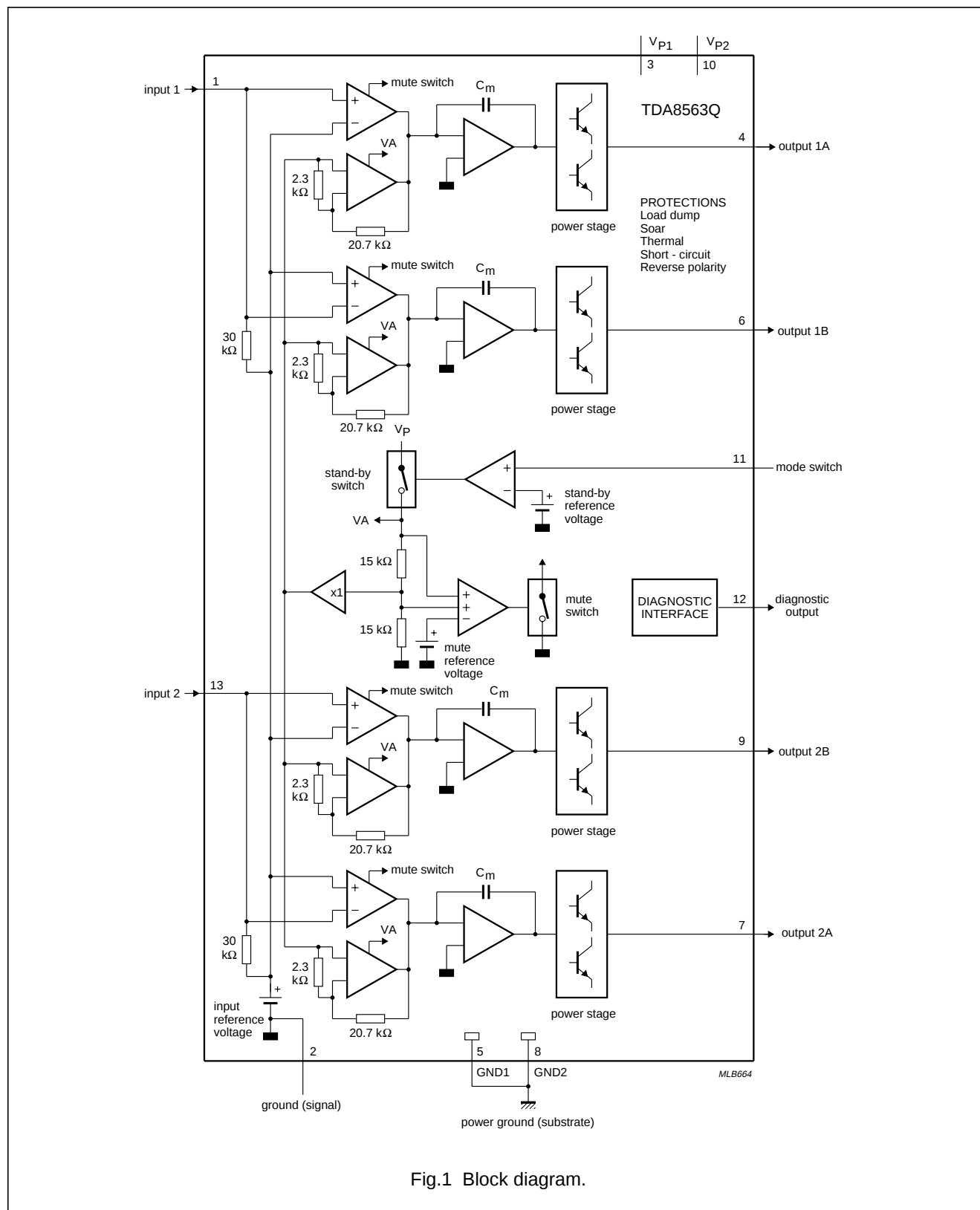
### ORDERING INFORMATION

| TYPE NUMBER | PACKAGE |                                                                  |          |
|-------------|---------|------------------------------------------------------------------|----------|
|             | NAME    | DESCRIPTION                                                      | VERSION  |
| TDA8563Q    | DBS13P  | plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm) | SOT141-6 |

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### BLOCK DIAGRAM



$2 \times 40\text{ W/2 } \Omega$  stereo BTL car radio power amplifier with diagnostic facility

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PINNING

| SYMBOL            | PIN | DESCRIPTION       |
|-------------------|-----|-------------------|
| IN 1              | 1   | input 1           |
| GND(S)            | 2   | signal ground     |
| V <sub>P1</sub>   | 3   | supply voltage 1  |
| OUT 1A            | 4   | output 1A         |
| GND1              | 5   | power ground 1    |
| OUT 1B            | 6   | output 1B         |
| OUT 2A            | 7   | output 2A         |
| GND2              | 8   | power ground 2    |
| OUT 2B            | 9   | output 2B         |
| V <sub>P2</sub>   | 10  | supply voltage 2  |
| MODE              | 11  | mode switch input |
| V <sub>DIAG</sub> | 12  | diagnostic output |
| IN 2              | 13  | input 2           |

FUNCTIONAL DESCRIPTION

The TDA8563Q contains two identical amplifiers and can be used for bridge applications. The gain of each amplifier is fixed at 26 dB. Special features of the device are as follows.

Mode select switch (pin 11)

- Standby: low supply current
- Mute: input signal suppressed
- Operating: normal on condition.

Since this pin has a very low input current (<40 µA), a low cost supply switch can be applied.

To avoid switch-on plops, it is advised to keep the amplifier in the mute mode during ≥100 ms (charging of the input capacitors at pin 1 and pin 13).

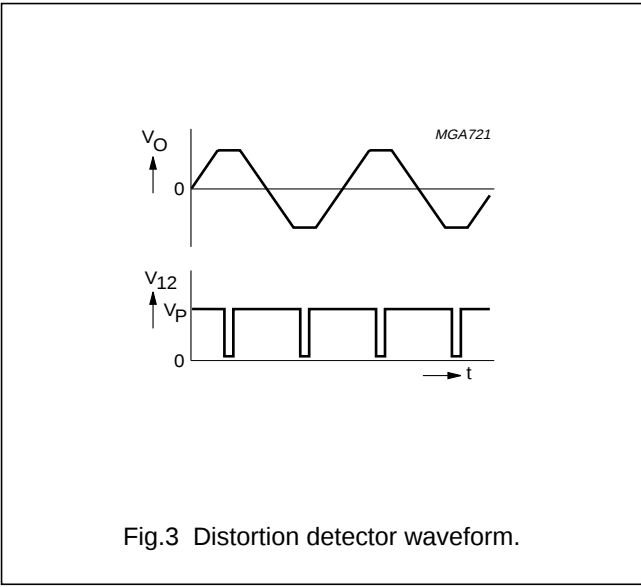
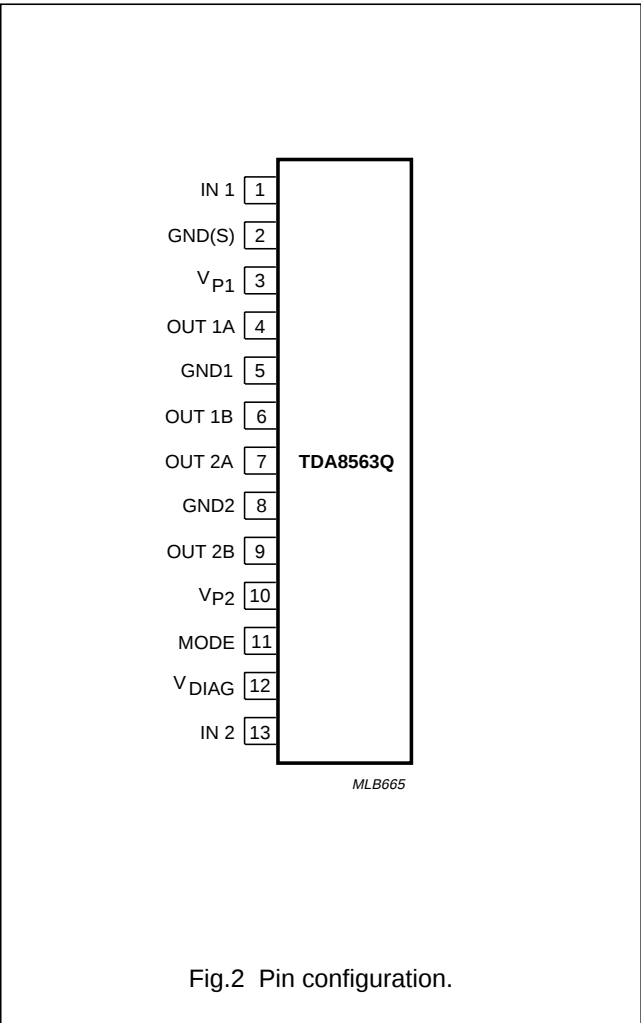
This can be achieved by:

- Microprocessor control
- External timing circuit (see Fig.7).

Diagnostic output (pin 12)

DYNAMIC DISTORTION DETECTOR (DDD)

At the onset of clipping of one or more output stages, the dynamic distortion detector becomes active and pin 12 goes LOW. This information can be used to drive a sound processor or DC volume control to attenuate the input signal and thus limit the distortion. The output level of pin 12 is independent of the number of channels that are clipping (see Fig.3).



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### SHORT-CIRCUIT PROTECTION

When a short-circuit occurs at one or more outputs to ground or to the supply voltage, the output stages are switched off until the short-circuit is removed and the device is switched on again, with a delay of approximately 20 ms, after removal of the short-circuit. During this short-circuit condition, pin 12 is continuously LOW.

When a short-circuit across the load of one or both channels occurs the output stages are switched off during approximately 20 ms. After that time it is checked during approximately 50 μs to see whether the short-circuit is still present. Due to this duty cycle of 50 μs/20 ms the average current consumption during this short-circuit condition is very low (approximately 40 mA).

During this short-circuit condition, pin 12 is LOW for 20 ms and HIGH for 50 μs (see Fig.4).

The power dissipation in any short-circuit condition is very low.

### TEMPERATURE DETECTION

When the virtual junction temperature  $T_{vj}$  reaches 150 °C, pin 12 will become continuously LOW.

### OPEN COLLECTOR OUTPUT

Pin 12 is an open collector output, which allows pin 12 of more devices being tied together.

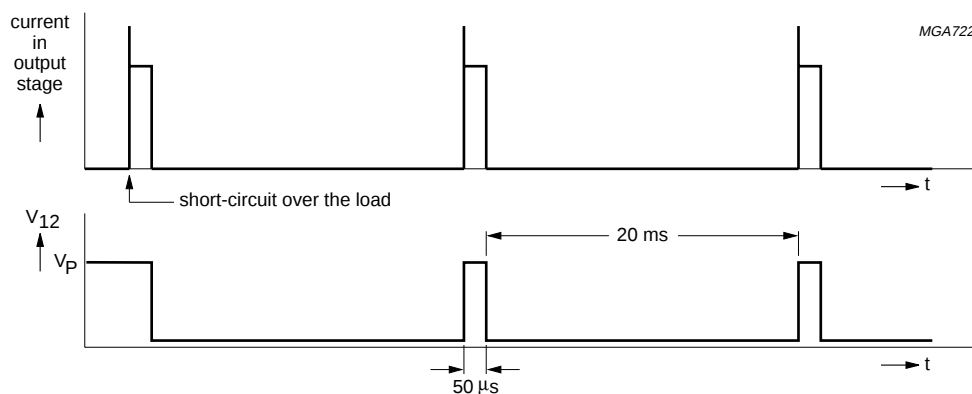


Fig.4 Short-circuit waveform.

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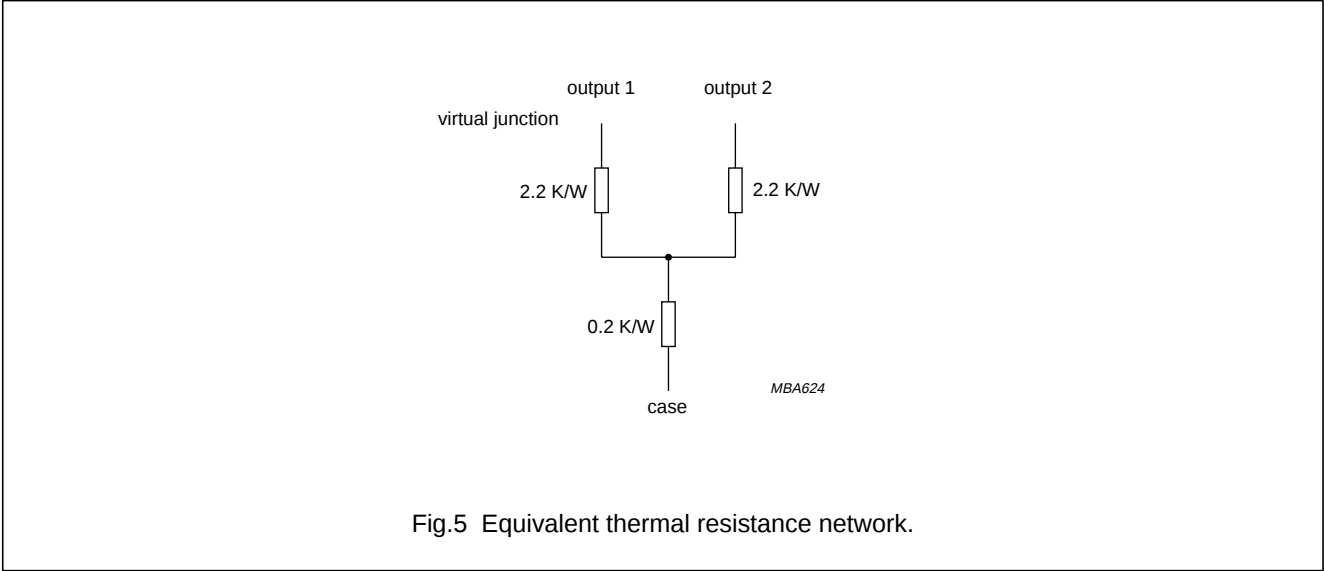
LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134).

| SYMBOL           | PARAMETER                            | CONDITIONS                            | MIN. | MAX. | UNIT |
|------------------|--------------------------------------|---------------------------------------|------|------|------|
| V <sub>P</sub>   | supply voltage                       |                                       | –    | 18   | V    |
|                  | operating                            |                                       | –    | 30   | V    |
|                  | non-operating                        |                                       | –    | 45   | V    |
|                  | load dump protection                 | during 50 ms; t <sub>r</sub> ≥ 2.5 ms | –    | 45   | V    |
| V <sub>psc</sub> | AC and DC short-circuit safe voltage |                                       | –    | 18   | V    |
| V <sub>rp</sub>  | reverse polarity                     |                                       | –    | 6    | V    |
| I <sub>OSM</sub> | non-repetitive peak output current   |                                       | –    | 10   | A    |
| I <sub>ORM</sub> | repetitive peak output current       |                                       | –    | 7.5  | A    |
| P <sub>tot</sub> | total power dissipation              |                                       | –    | 60   | W    |
| T <sub>stg</sub> | storage temperature                  |                                       | –55  | +150 | °C   |
| T <sub>amb</sub> | ambient temperature                  |                                       | –40  | +85  | °C   |
| T <sub>vj</sub>  | virtual junction temperature         |                                       | –    | 150  | °C   |

THERMAL CHARACTERISTICS

| SYMBOL               | PARAMETER                                               | VALUE | UNIT |
|----------------------|---------------------------------------------------------|-------|------|
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient in free air | 40    | K/W  |
| R <sub>th(j-c)</sub> | thermal resistance from junction to case (see Fig.5)    | 1.3   | K/W  |



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### DC CHARACTERISTICS

$V_P = 14.4\text{ V}$ ;  $T_{\text{amb}} = 25\text{ °C}$ ; measured in Fig.6; unless otherwise specified.

| SYMBOL                     | PARAMETER                      | CONDITIONS                    | MIN. | TYP. | MAX.  | UNIT |
|----------------------------|--------------------------------|-------------------------------|------|------|-------|------|
| <b>Supply</b>              |                                |                               |      |      |       |      |
| $V_P$                      | supply voltage                 | note 1                        | 6.0  | 14.4 | 18    | V    |
| $I_q$                      | quiescent current              | $R_L = \infty$                | –    | 115  | 180   | mA   |
| <b>Operating condition</b> |                                |                               |      |      |       |      |
| $V_{11}$                   | mode switch voltage level      |                               | 8.5  | –    | $V_P$ | V    |
| $I_{11}$                   | mode switch current            | $V_{11} = 14.4\text{ V}$      | –    | 15   | 40    | μA   |
| $V_O$                      | DC output voltage              | note 2                        | –    | 7.0  | –     | V    |
| $V_{OO}$                   | DC output offset voltage       |                               | –    | –    | 100   | mV   |
| <b>Mute condition</b>      |                                |                               |      |      |       |      |
| $V_{11}$                   | mode switch voltage level      |                               | 3.3  | –    | 6.4   | V    |
| $V_O$                      | DC output voltage              | note 2                        | –    | 7.0  | –     | V    |
| $V_{OO}$                   | DC output offset voltage       |                               | –    | –    | 60    | mV   |
| $\Delta V_{OO}$            | DELTA DC output offset voltage | mute/operating                | –    | –    | 60    | mV   |
| <b>Standby condition</b>   |                                |                               |      |      |       |      |
| $V_{11}$                   | mode switch voltage level      |                               | 0    | –    | 2     | V    |
| $I_{\text{stb}}$           | standby current                |                               | –    | 0.1  | 10    | μA   |
| <b>Diagnostic output</b>   |                                |                               |      |      |       |      |
| $V_{12}$                   | diagnostic output voltage      | any short-circuit or clipping | –    | –    | 0.6   | V    |

### Notes

1. The circuit is DC adjusted at  $V_P = 6$  to  $18\text{ V}$  and AC operating at  $V_P = 8.5$  to  $18\text{ V}$ .
2. At  $18\text{ V} < V_P < 30\text{ V}$  the DC output voltage  $\leq \frac{1}{2}V_P$ .

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### AC CHARACTERISTICS

$V_P = 14.4\text{ V}$ ;  $R_L = 2\ \Omega$ ;  $f = 1\text{ kHz}$ ;  $T_{\text{amb}} = 25\text{ °C}$ ; measured in Fig.6; unless otherwise specified.

| SYMBOL               | PARAMETER                          | CONDITIONS                                            | MIN. | TYP.        | MAX. | UNIT |
|----------------------|------------------------------------|-------------------------------------------------------|------|-------------|------|------|
| $P_o$                | output power                       | THD = 0.5%                                            | 25   | 30          | –    | W    |
|                      |                                    | THD = 10%                                             | 33   | 40          | –    | W    |
|                      |                                    | THD = 30%                                             | 45   | 55          | –    | W    |
|                      |                                    | THD = 0.5%; $V_P = 13.2\text{ V}$                     | –    | 25          | –    | W    |
|                      |                                    | THD = 10%; $V_P = 13.2\text{ V}$                      | –    | 35          | –    | W    |
| THD                  | total harmonic distortion          | $P_o = 1\text{ W}$                                    | –    | 0.1         | –    | %    |
|                      |                                    | $V_{12} \leq 0.6\text{ V}$ ; note 1                   | –    | 10          | –    | %    |
| B                    | power bandwidth                    | THD = 0.5%; $P_o = -1\text{ dB}$ with respect to 25 W | –    | 20 to 20000 | –    | Hz   |
| $f_{ro(l)}$          | low frequency roll-off             | at $-1\text{ dB}$ ; note 2                            | –    | 25          | –    | Hz   |
| $f_{ro(h)}$          | high frequency roll-off            | at $-1\text{ dB}$                                     | 20   | –           | –    | kHz  |
| $G_v$                | closed loop voltage gain           |                                                       | 25   | 26          | 27   | dB   |
| SVRR                 | supply voltage ripple rejection on | note 3                                                | 50   | –           | –    | dB   |
|                      | mute                               | note 3                                                | 50   | –           | –    | dB   |
|                      | standby                            | note 3                                                | 80   | –           | –    | dB   |
| $ Z_i $              | input impedance                    |                                                       | 25   | 30          | 38   | kΩ   |
| $V_{n(o)}$           | noise output voltage on            | note 4                                                | –    | 85          | 120  | μV   |
|                      | on                                 | note 5                                                | –    | 100         | –    | μV   |
|                      | mute                               | note 6                                                | –    | 60          | –    | μV   |
| $\alpha_{CS}$        | channel separation                 | note 7                                                | 45   | –           | –    | dB   |
| $ \Delta G_v $       | channel unbalance                  |                                                       | –    | –           | 1    | dB   |
| $V_{o(\text{mute})}$ | output voltage in mute             | note 8                                                | –    | –           | 2    | mV   |

### Notes

1. Dynamic distortion detector active.
2. Frequency response externally fixed.
3.  $V_{\text{ripple}} = V_{\text{ripple(max)}} = 2\text{ V (p-p)}$ ;  $R_S = 0\ \Omega$ .
4.  $B = 20\text{ Hz to }20\text{ kHz}$ ;  $R_S = 0\ \Omega$ .
5.  $B = 20\text{ Hz to }20\text{ kHz}$ ;  $R_S = 10\text{ k}\Omega$ .
6.  $B = 20\text{ Hz to }20\text{ kHz}$ ; independent of  $R_S$ .
7.  $P_o = 25\text{ W}$ ;  $R_S = 10\text{ k}\Omega$ .
8.  $V_i = V_{i(\text{max})} = 1\text{ V (RMS)}$ .

# $2 \times 40 \text{ W}/2 \Omega$ stereo BTL car radio power amplifier with diagnostic facility

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## AC CHARACTERISTICS

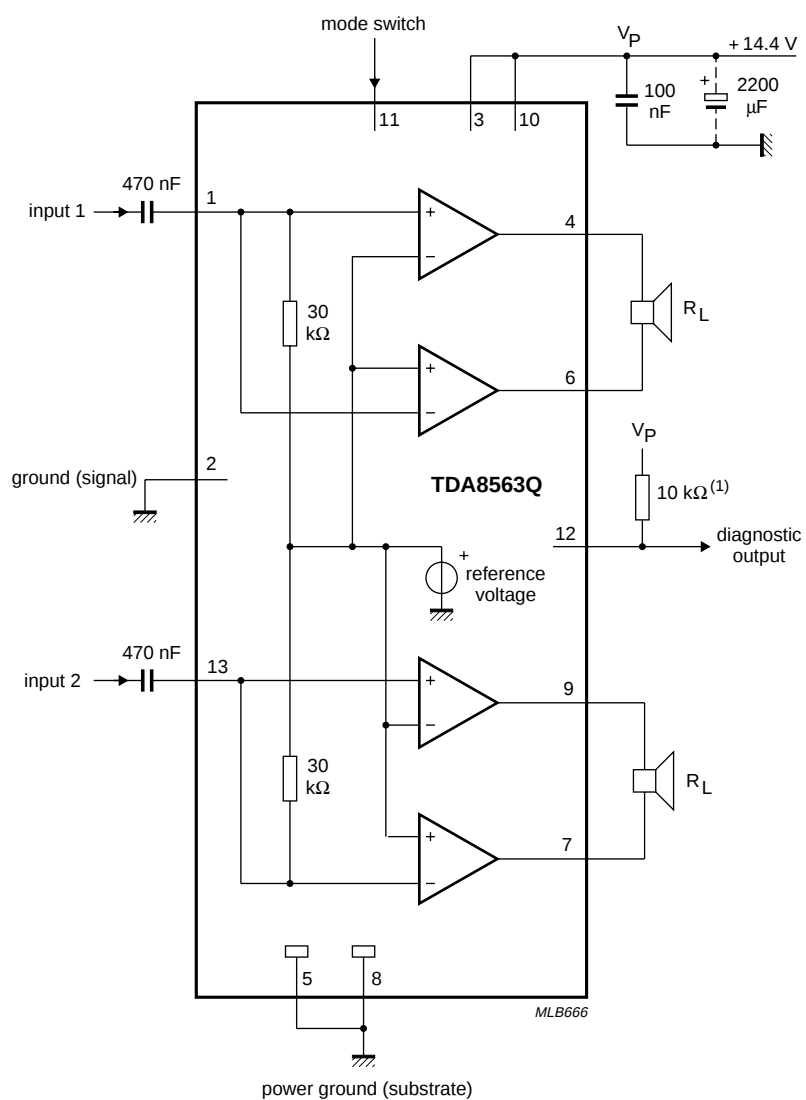
$V_P = 14.4 \text{ V}$ ;  $R_L = 4 \Omega$ ;  $f = 1 \text{ kHz}$ ;  $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ ; measured in Fig.6; unless otherwise specified.

| SYMBOL | PARAMETER                 | CONDITIONS                         | MIN. | TYP. | MAX. | UNIT |
|--------|---------------------------|------------------------------------|------|------|------|------|
| $P_o$  | output power              | THD = 0.5%                         | 16   | 19   | –    | W    |
|        |                           | THD = 10%                          | 21   | 25   | –    | W    |
|        |                           | THD = 30%                          | 28   | 35   | –    | W    |
|        |                           | THD = 0.5%; $V_P = 13.2 \text{ V}$ | –    | 15   | –    | W    |
|        |                           | THD = 10%; $V_P = 13.2 \text{ V}$  | –    | 21   | –    | W    |
| THD    | total harmonic distortion | $P_o = 1 \text{ W}$                | –    | 0.1  | –    | %    |

# $2 \times 40\text{ W}/2\ \Omega$ stereo BTL car radio power amplifier with diagnostic facility

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## TEST AND APPLICATION INFORMATION



(1) To avoid high energy switching pulses which can feedback to the inputs it is advisable to ensure that the value of the resistor at pin 12 is  $\geq 10\text{ k}\Omega$ .

Fig.6 Stereo BTL test/application diagram.

2 × 40 W/2 Ω stereo BTL car radio power amplifier with diagnostic facility

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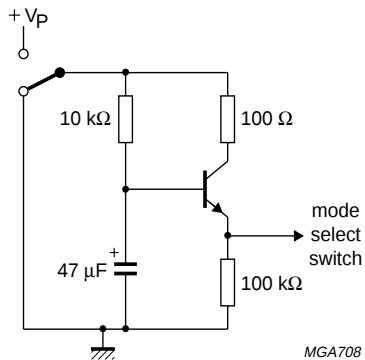


Fig.7 Mode select switch circuitry.

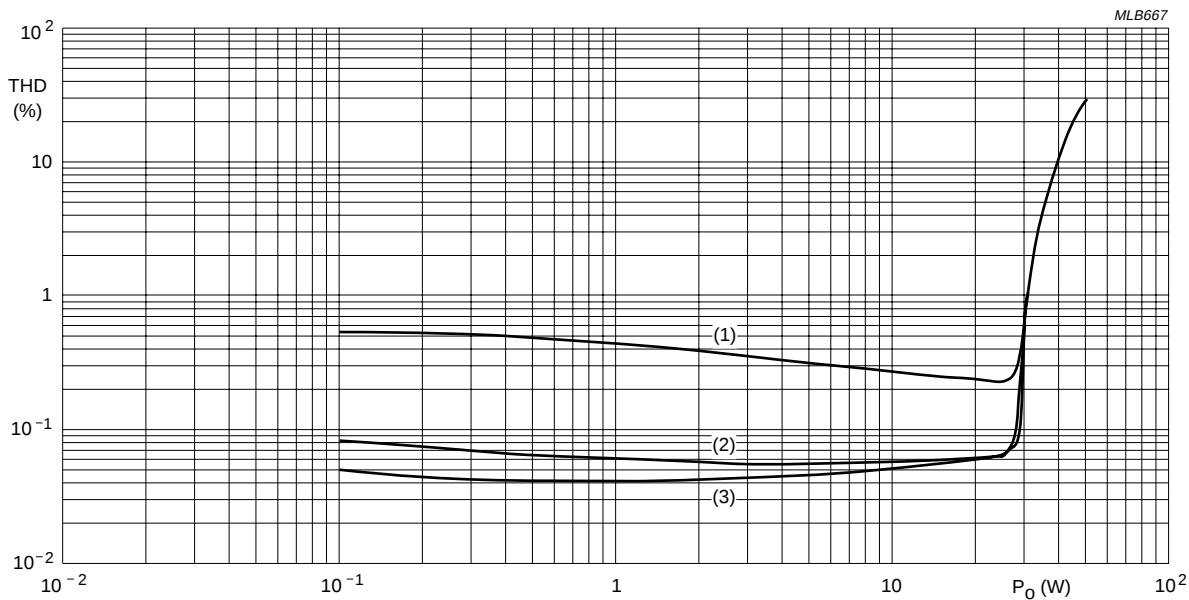
Diagnostic output

Special care must be taken in the printed-circuit board layout to separate pin 12 from pin 1 and pin 13, to minimize the crosstalk between the diagnostic output and the inputs.

Mode select switch

To avoid switch-on plops, it is advised to keep the amplifier in the mute mode during >100 ms (charging of the input capacitors at pin 1 and pin 13).

The circuit in Fig.7 slowly ramps up the voltage at the mode select switch pin when switching on and results in fast muting when switching off.

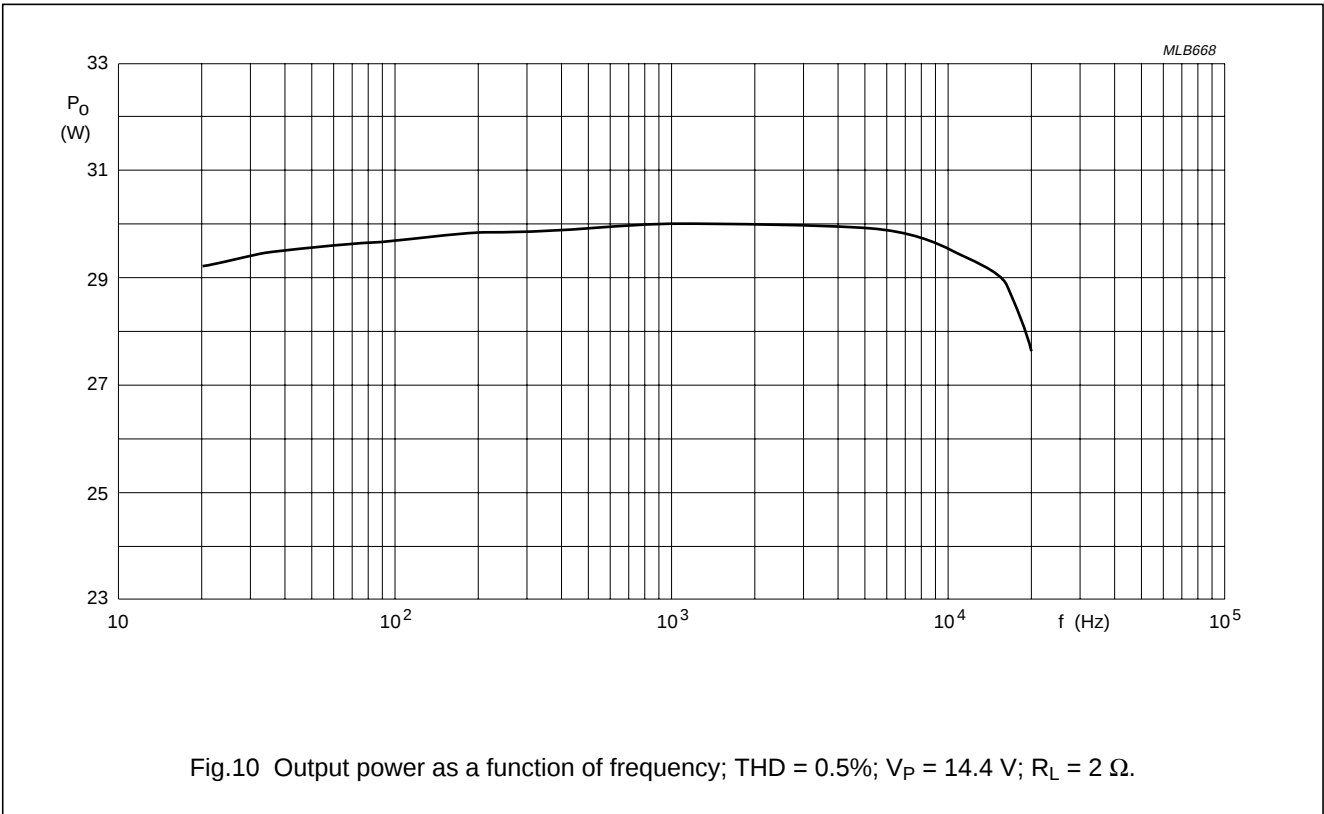
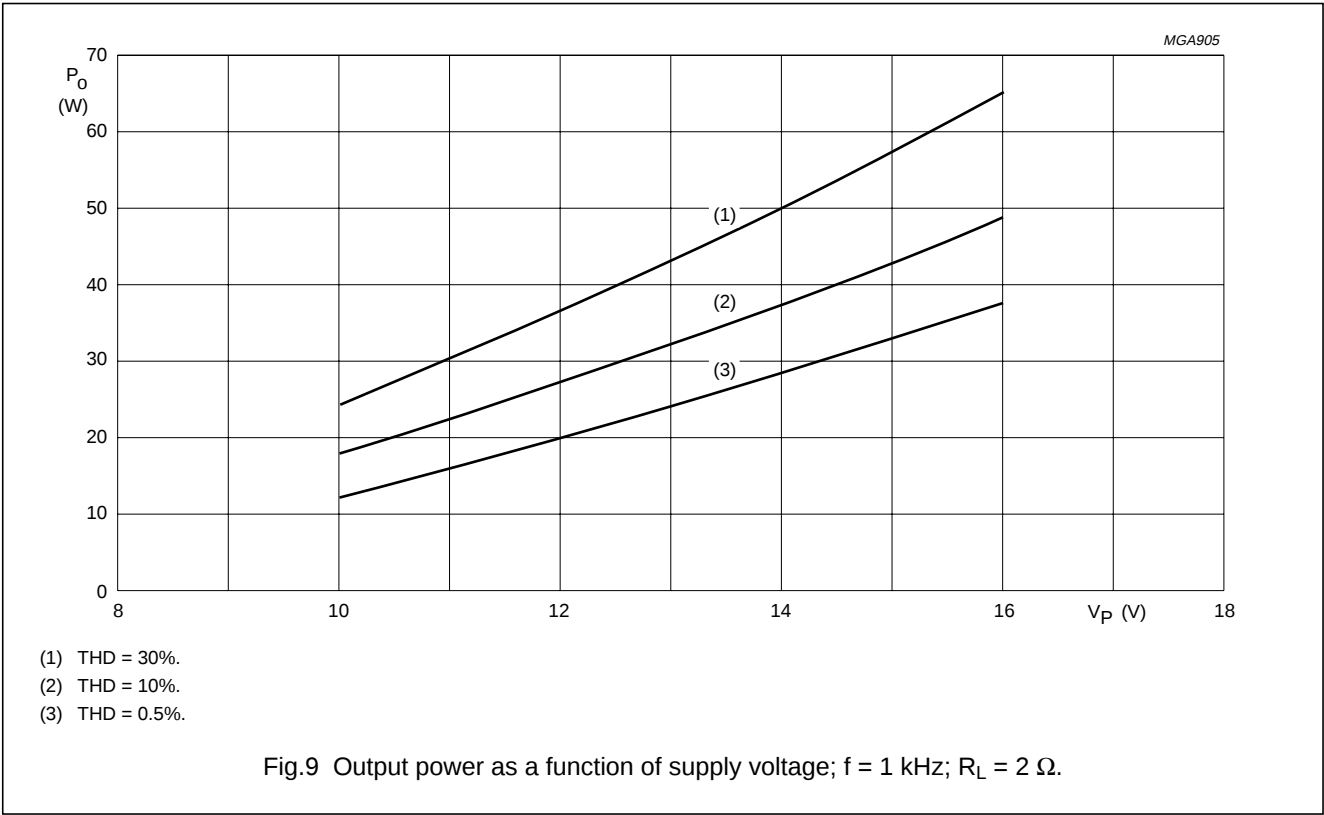


- (1) f = 10 kHz.
- (2) f = 1 Hz.
- (3) f = 100 Hz.

Fig.8 Total harmonic distortion as a function of output power;  $V_P = 14.4\text{ V}$ ;  $R_L = 2\text{ }\Omega$ .

2 × 40 W/2 Ω stereo BTL car radio power  
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## 2 × 40 W/2 Ω stereo BTL car radio power amplifier with diagnostic facility

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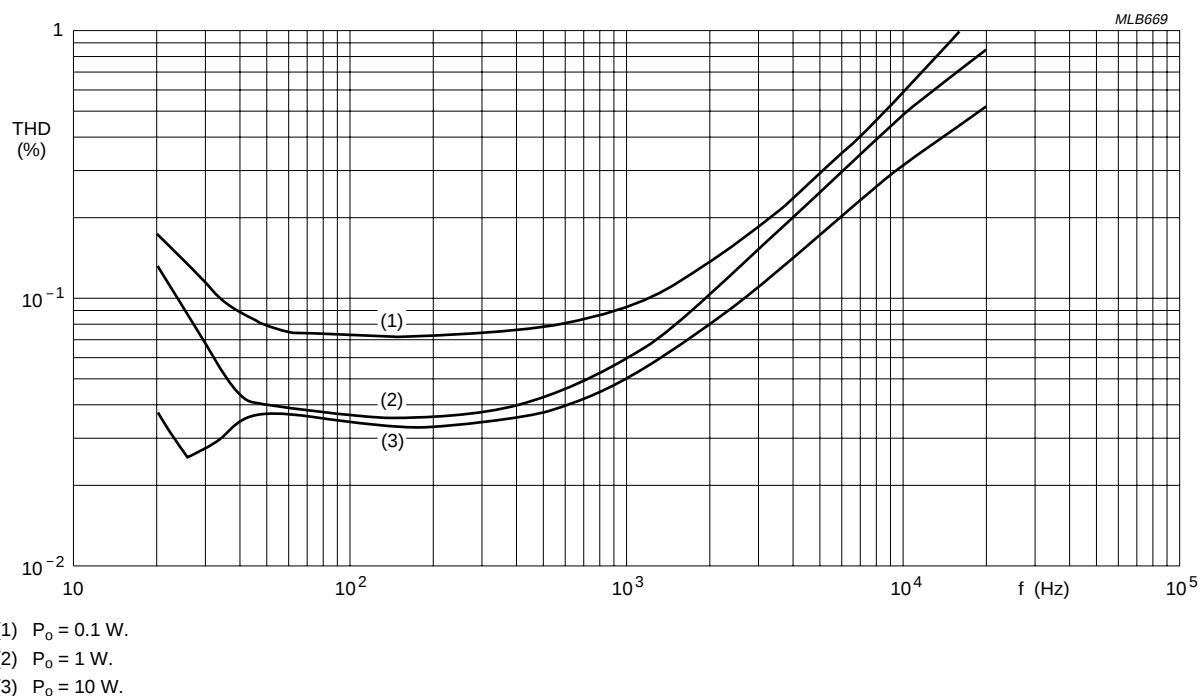


Fig.11 Total harmonic distortion as a function of frequency;  $V_P = 14.4$  V;  $R_L = 2$  Ω.

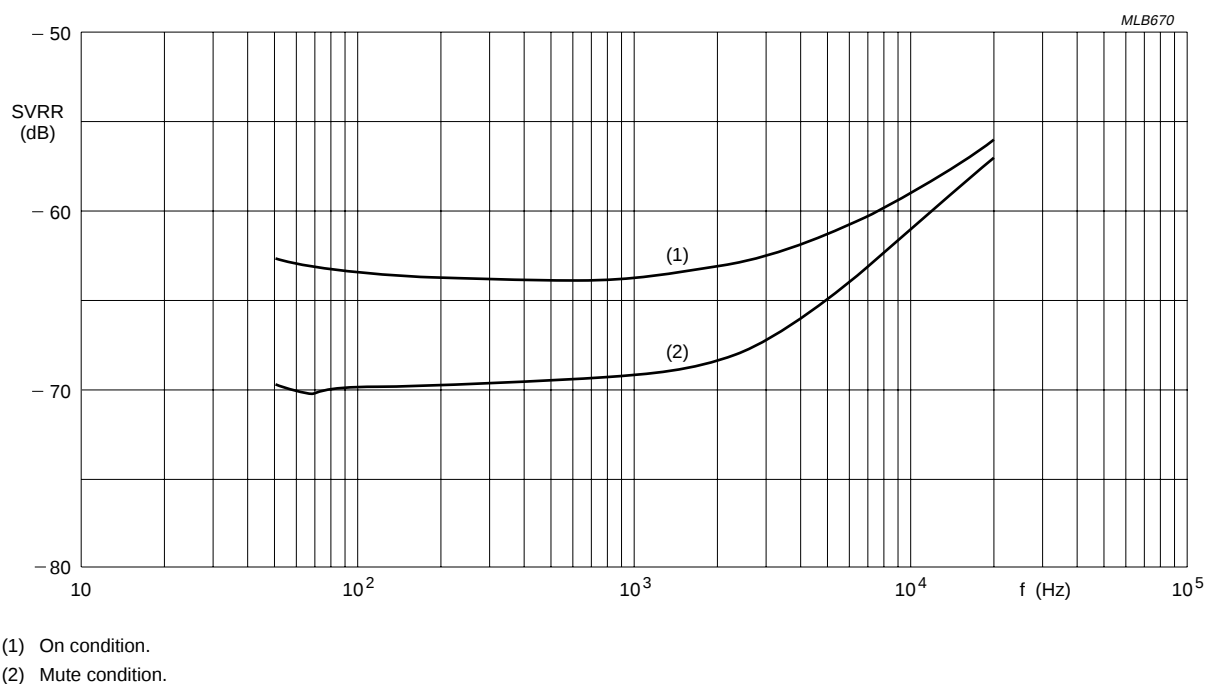


Fig.12 Ripple rejection as a function of frequency;  $V_P = 14.4$  V;  $V_{\text{ripple}} = 2$  V (p-p);  $R_s = 0$  Ω.

$2 \times 40\text{ W}/2\ \Omega$  stereo BTL car radio power  
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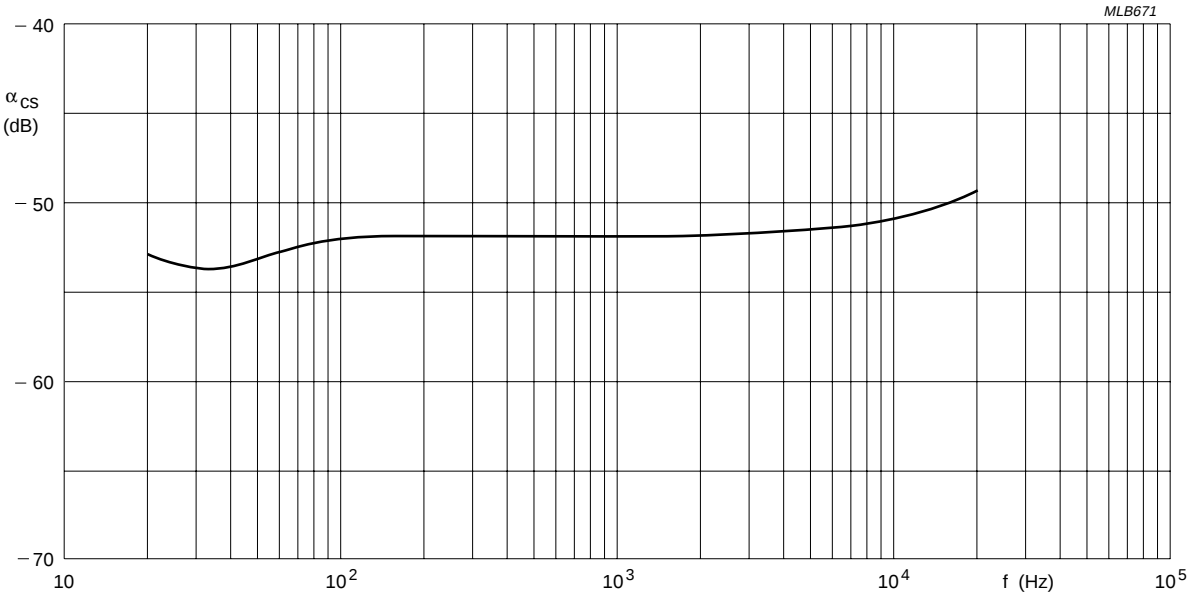


Fig.13 Channel separation as a function of frequency;  $V_P = 14.4\text{ V}$ ;  $P_O = 25\text{ W}$ ;  $R_L = 2\ \Omega$ ;  $R_S = 10\text{ k}\Omega$ .

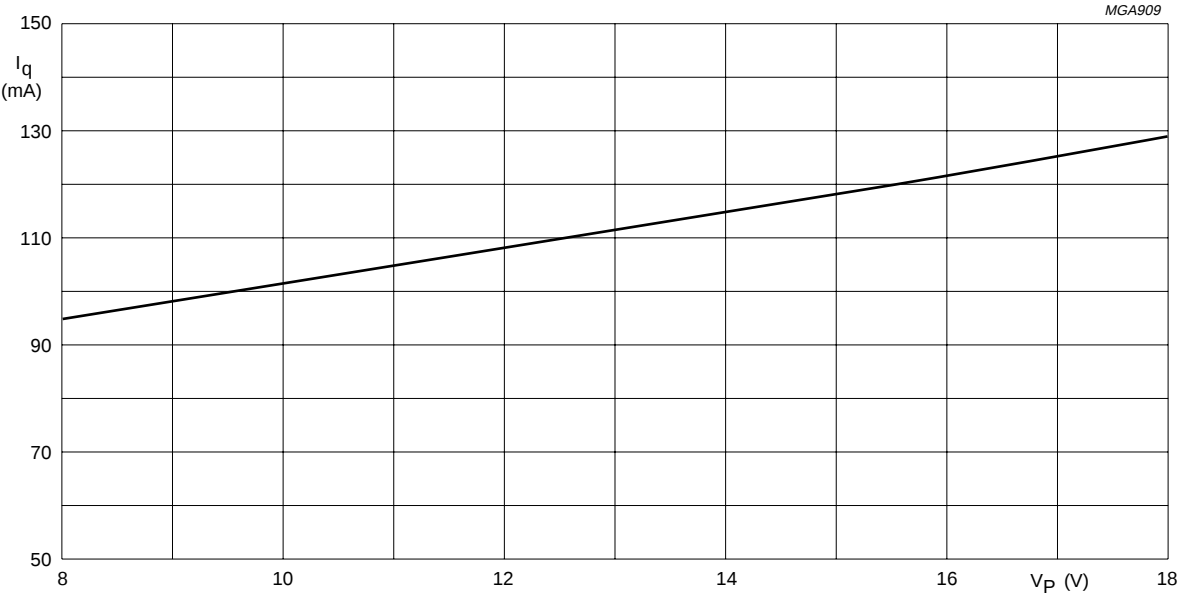


Fig.14 Quiescent current as a function of supply voltage;  $R_L = \infty$ .

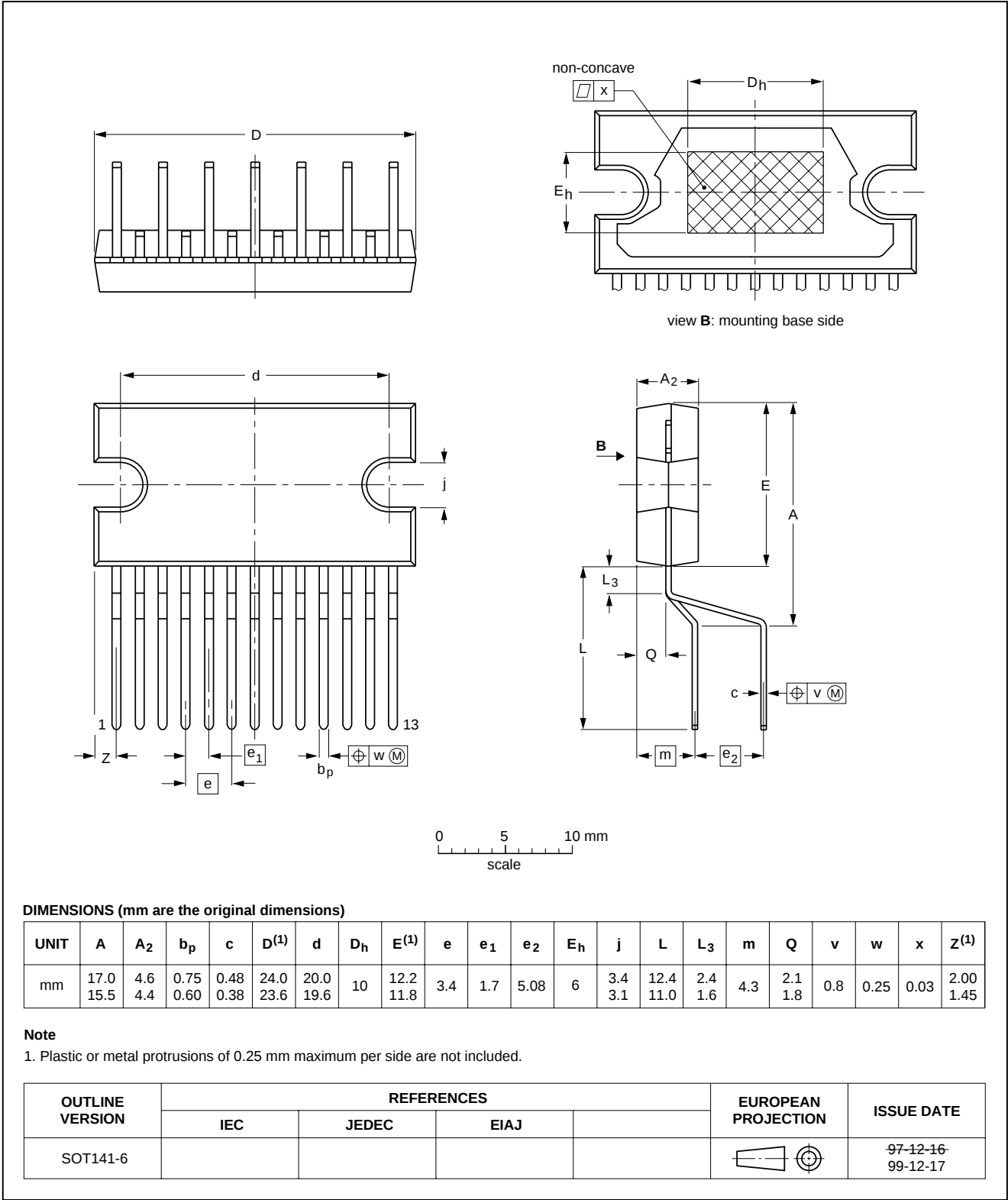
$2 \times 40\text{ W/2 } \Omega$  stereo BTL car radio power amplifier with diagnostic facility

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PACKAGE OUTLINE

DBS13P: plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm)

SOT141-6



2 × 40 W/2 Ω stereo BTL car radio power amplifier with diagnostic facility

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SOLDERING

Introduction to soldering through-hole mount packages

This text gives a brief insight to wave, dip and manual soldering. A more in-depth account of soldering ICs can be found in our *“Data Handbook IC26; Integrated Circuit Packages”* (document order number 9398 652 90011).

Wave soldering is the preferred method for mounting of through-hole mount IC packages on a printed-circuit board.

Soldering by dipping or by solder wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joints for more than 5 seconds.

The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature (T<sub>stg(max)</sub>). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

Manual soldering

Apply the soldering iron (24 V or less) to the lead(s) of the package, either below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

Suitability of through-hole mount IC packages for dipping and wave soldering methods

| PACKAGE                   | SOLDERING METHOD |                         |
|---------------------------|------------------|-------------------------|
|                           | DIPPING          | WAVE                    |
| DBS, DIP, HDIP, SDIP, SIL | suitable         | suitable <sup>(1)</sup> |

Note

1. For SDIP packages, the longitudinal axis must be parallel to the transport direction of the printed-circuit board.

## 2 × 40 W/2 Ω stereo BTL car radio power amplifier with diagnostic facility

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### DATA SHEET STATUS

| DATA SHEET STATUS         | PRODUCT STATUS | DEFINITIONS <sup>(1)</sup>                                                                                                                                                                                                                                 |
|---------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objective specification   | Development    | This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.                                                                                                          |
| Preliminary specification | Qualification  | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |
| Product specification     | Production     | This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.                                                       |

### Note

1. Please consult the most recently issued data sheet before initiating or completing a design.

### DEFINITIONS

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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.

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NOTES

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$2 \times 40\text{ W}/2\ \Omega$  stereo BTL car radio power  
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NOTES

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