

DATA SHEET

TDA7056B

**5 W mono BTL audio amplifier with
DC volume control**

Product specification
Supersedes data of 1996 May 28

1997 Aug 15



5 W mono BTL audio amplifier with DC volume control

TDA7056B

FEATURES

- DC volume control
- Few external components
- Mute mode
- Thermal protection
- Short-circuit proof
- No switch-on and switch-off clicks
- Good overall stability
- Low power consumption
- Low HF radiation
- ESD protected on all pins.

GENERAL DESCRIPTION

The TDA7056B is a mono Bridge-Tied Load (BTL) output amplifier with DC volume control.

It is designed for use in TV and monitors, but is also suitable for battery-fed portable recorders and radios. The device is contained in a 9-pin medium power package.

A Missing Current Limiter (MCL) is built in. The MCL circuit is activated when the difference in current between the output terminal of each amplifier exceeds 100 mA (300 mA typ.). This level of 100 mA allows for headphone applications (single-ended).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_P	supply voltage		4.5	–	18	V
P_O	output power	$V_P = 12\text{ V}$ $R_L = 16\ \Omega$ $R_L = 8\ \Omega$	3 5	3.5 5.5	– –	W W
$G_{v(max)}$	maximum total voltage gain		39.5	40.5	41.5	dB
ϕ	gain control		68	73.5	–	dB
$I_{q(tot)}$	total quiescent current	$V_P = 12\text{ V}; R_L = \infty$	–	9.2	13	mA
THD	total harmonic distortion	$P_O = 0.5\text{ W}$	–	0.3	1	%

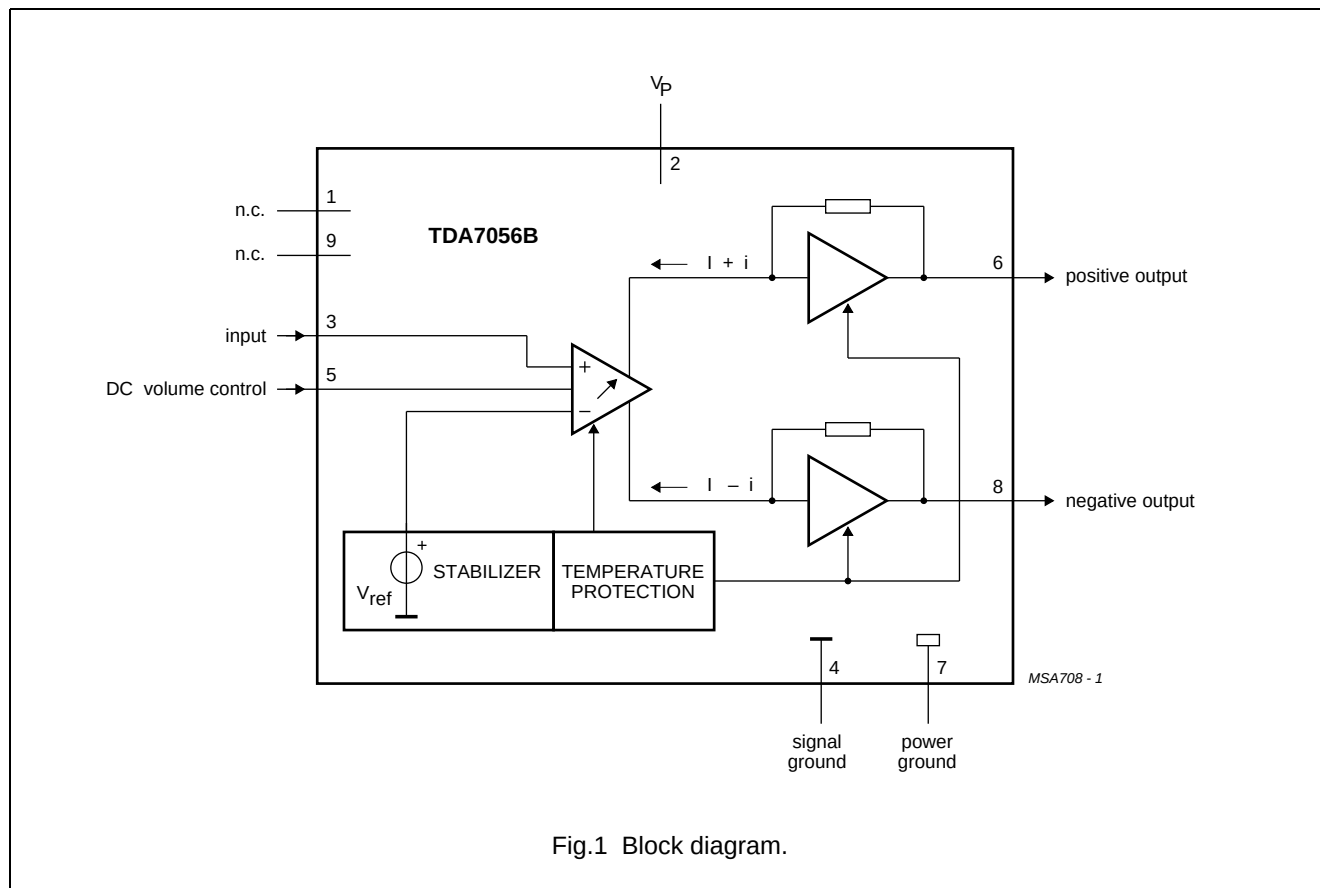
ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA7056B	SIL9MPF	plastic single in-line medium power package with fin; 9 leads	SOT110-1

5 W mono BTL audio amplifier with DC volume control

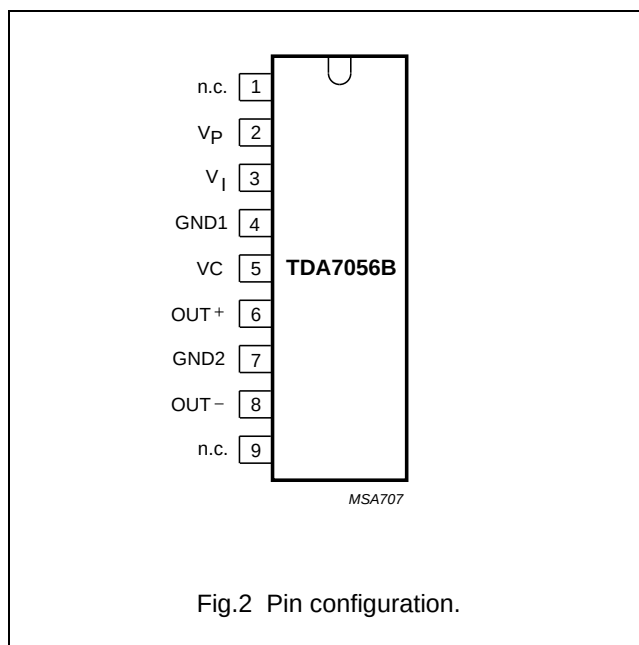
TDA7056B

BLOCK DIAGRAM



PINNING

SYMBOL	PIN	DESCRIPTION
n.c.	1	not connected
V_P	2	positive supply voltage
V_I	3	voltage input
GND1	4	signal ground
VC	5	DC volume control
OUT+	6	positive output
GND2	7	power ground
OUT-	8	negative output
n.c.	9	not connected



5 W mono BTL audio amplifier with DC volume control

TDA7056B

FUNCTIONAL DESCRIPTION

The TDA7056B is a mono BTL output amplifier with DC volume control, designed for use in TV and monitor but is also suitable for battery-fed portable recorders and radios.

In conventional DC volume circuits the control or input stage is AC coupled to the output stage via external capacitors to keep the offset voltage low. In the TDA7056B the DC volume control stage is integrated into the input stage so that no coupling capacitors are required. With this configuration, a low offset voltage is still maintained and the minimum supply voltage remains low.

The BTL principle offers the following advantages:

- Lower peak value of the supply current
- The frequency of the ripple on the supply voltage is twice the signal frequency.

Consequently, a reduced power supply with smaller capacitors can be used which results in cost reductions. For portable applications there is a trend to decrease the supply voltage, resulting in a reduction of output power at conventional output stages. Using the BTL principle increases the output power.

The maximum gain of the amplifier is fixed at 40.5 dB.

The DC volume control stage has a logarithmic control characteristic. Therefore, the total gain can be controlled from 40.5 dB to -33 dB. If the DC volume control voltage falls below 0.4 V, the device will switch to the mute mode.

The amplifier is short-circuit proof to ground, V_P and across the load. Also a thermal protection circuit is implemented. If the crystal temperature rises above +150 °C the gain will be reduced, thereby reducing the output power. Special attention is given to switch-on and switch-off clicks, low HF radiation and a good overall stability.

Power dissipation

Assume $V_P = 12$ V; $R_L = 16$ Ω.

The maximum sine wave dissipation is = 1.8 W.

The $R_{th\ vj-a}$ of the package is 55 K/W.

Therefore $T_{amb\ (max)} = 150 - 55 \times 1.8 = 51$ °C.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_P	supply voltage		–	18	V
$V_{3,5}$	input voltage pins 3 and 5		–	5	V
I_{ORM}	repetitive peak output current		–	1.25	A
I_{OSM}	non-repetitive peak output current		–	1.5	A
P_{tot}	total power dissipation	$T_{case} < 60$ °C	–	9	W
T_{amb}	operating ambient temperature		–40	+85	°C
T_{stg}	storage temperature		–55	+150	°C
T_{vj}	virtual junction temperature		–	+150	°C
T_{sc}	short-circuit time		–	1	h

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient in free air	55	K/W
$R_{th\ j-c}$	thermal resistance from junction to case	10	K/W

5 W mono BTL audio amplifier with DC volume control

TDA7056B

CHARACTERISTICS

$V_P = 12\text{ V}$; $V_{DC} = 1.4\text{ V}$; $f = 1\text{ kHz}$; $R_L = 16\ \Omega$; $T_{amb} = 25\text{ }^\circ\text{C}$; unless otherwise specified (see Fig.13).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_P	positive supply voltage		4.5	–	18	V
$I_{Q(tot)}$	total quiescent current	note 1; $R_L = \infty$	–	9.2	13	mA
Maximum gain ($V_5 = 1.4\text{ V}$)						
P_O	output power	THD = 10%; $R_L = 16\ \Omega$	3	3.5	–	W
		THD = 10%; $R_L = 8\ \Omega$	5	5.5	–	W
THD	total harmonic distortion	$P_O = 0.5\text{ W}$	–	0.3	1	%
$G_{V(max)}$	maximum total voltage gain		39.5	40.5	41.5	dB
V_I	input signal handling (RMS value)	$G_{V(max)} = 0\text{ dB}$; THD < 1%	1.0	–	–	V
V_{no}	noise output voltage (RMS value)	note 2; $f = 500\text{ kHz}$	–	210	–	μV
B	bandwidth	at –1 dB	–	0.02 to 300	–	kHz
SVRR	supply voltage ripple rejection	note 3	34	38	–	dB
$ \Delta V_O $	DC output offset voltage	$ V_8 - v_6 $	–	0	200	mV
Z_I	input impedance (pin 3)		15	20	25	k Ω
Mute position						
V_O	output voltage in mute position	note 4; $V_5 \leq 0.4\text{ V}$; $V_I = 1.0\text{ V}$	–	35	45	μV
DC volume control; note 5						
ϕ	gain control		68	73.5	–	dB
I_5	control current	$V_5 = 0\text{ V}$	–20	–25	–30	μA

Notes

- With a load connected to the outputs the quiescent current will increase, the maximum value of this increase being equal to the DC output offset voltage divided by R_L .
- The noise output voltage (RMS value) at $f = 500\text{ kHz}$ is measured with $R_S = 0\ \Omega$ and $B = 5\text{ kHz}$.
- The ripple rejection is measured with $R_S = 0\ \Omega$ and $f = 100\text{ Hz}$ to 10 kHz . The ripple voltage V_R of 200 mV (RMS value) is applied to the positive supply rail.
- The noise output voltage (RMS value) is measured with $R_S = 5\text{ k}\Omega$ unweighted.
- The DC volume control can be configured in several ways. Two possible circuits are shown in Figs 14 and 15. The circuits at the volume control pin will influence the switch-on and switch-off behaviour and the maximum voltage gain.

5 W mono BTL audio amplifier with DC volume control

TDA7056B

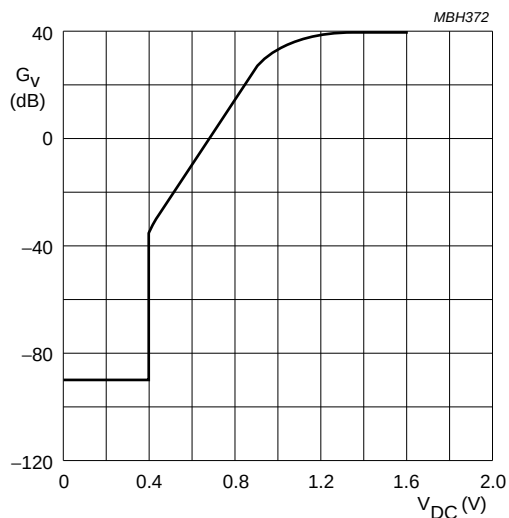
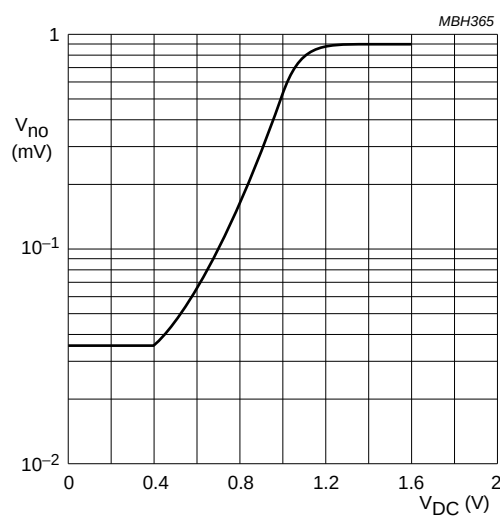


Fig.3 Gain control as a function of DC volume control.



Measured with $R_S = 5\text{ k}\Omega$ unweighted.
Frequency range is 22 Hz to 22 kHz.

Fig.4 Noise output voltage as a function of DC volume control.

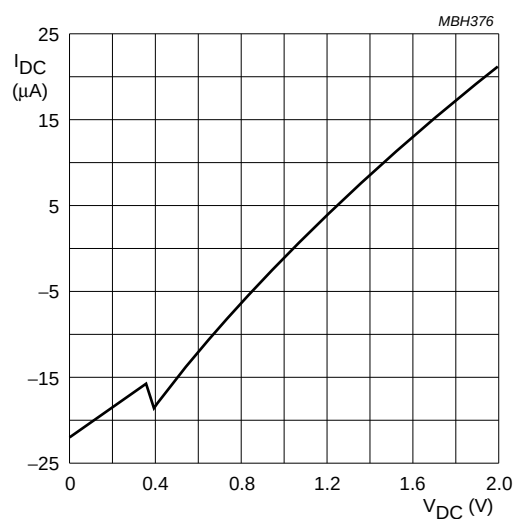
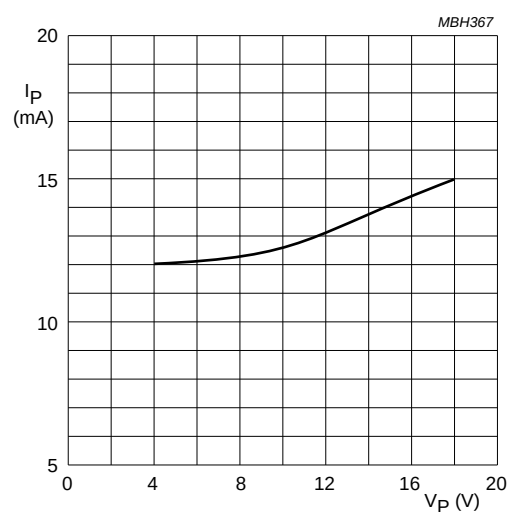


Fig.5 Control current as a function of DC volume control.

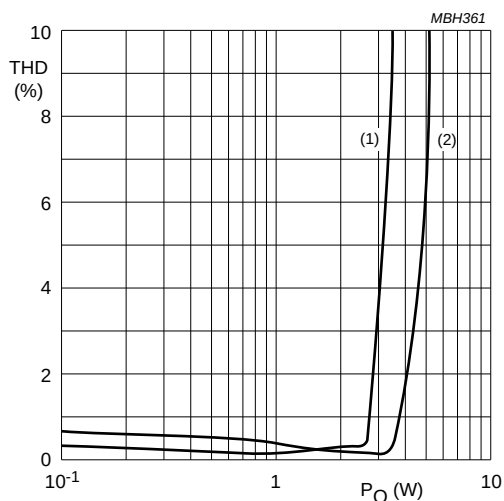


Measured with $R_L = \infty$.

Fig.6 Quiescent current versus supply voltage.

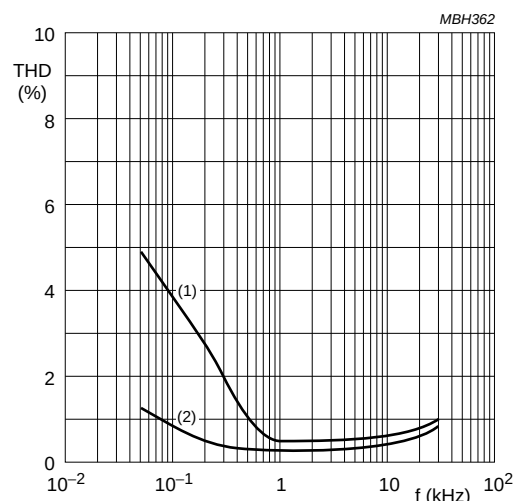
5 W mono BTL audio amplifier with DC volume control

TDA7056B



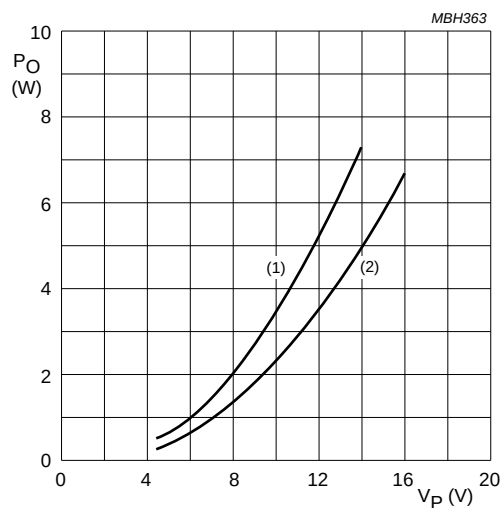
- (1) $R_L = 16 \Omega$.
(2) $R_L = 8 \Omega$.

Fig.7 Total harmonic distortion versus output power.



- $P_O = 0.1 \text{ W}$.
(1) $G_{V(\max)} = 40 \text{ dB}$.
(2) $G_{V(\max)} = 30 \text{ dB}$.

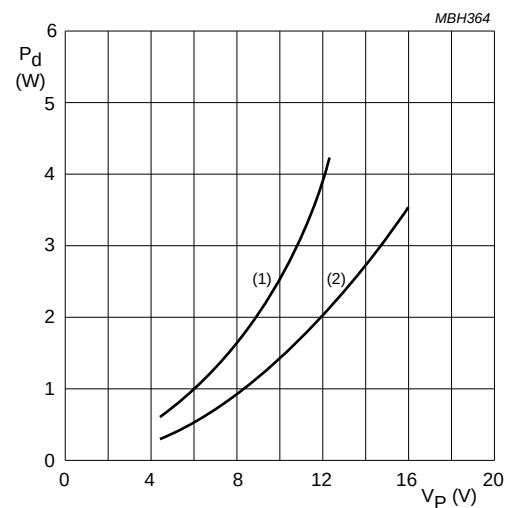
Fig.8 Total harmonic distortion versus frequency.



Measured at a THD of 10%. The maximum output power is limited by the maximum power dissipation and the maximum available output current.

- (1) $R_L = 8 \Omega$.
(2) $R_L = 16 \Omega$.

Fig.9 Output power versus supply voltage.

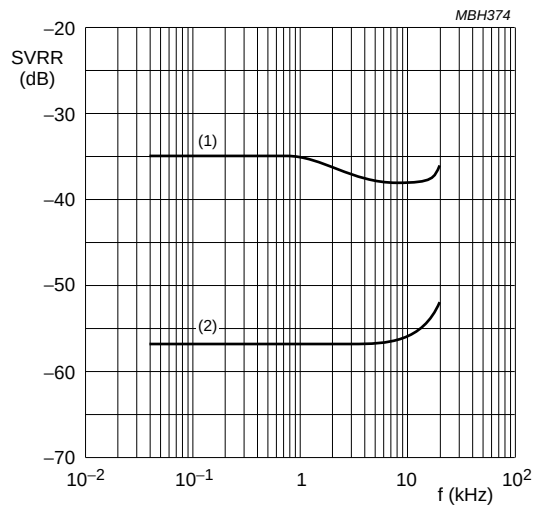


- (1) $R_L = 8 \Omega$.
(2) $R_L = 16 \Omega$.

Fig.10 Total worst case power dissipation versus supply voltage.

5 W mono BTL audio amplifier with DC volume control

TDA7056B

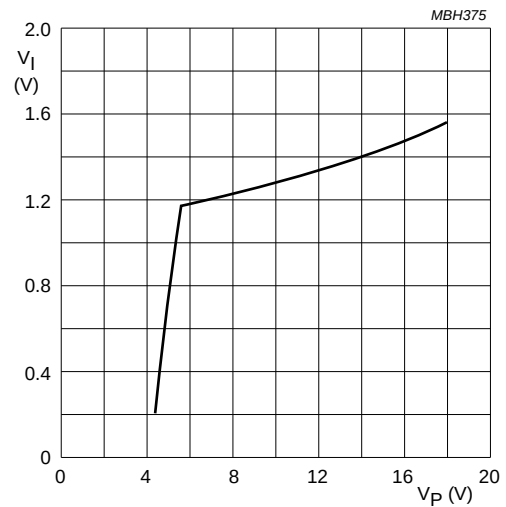


Measured with $V_R = 0.2$ V.

(1) $V_{DC} = 1.4$ V.

(2) $V_{DC} = 0.4$ V.

Fig.11 Supply voltage ripple rejection versus frequency.



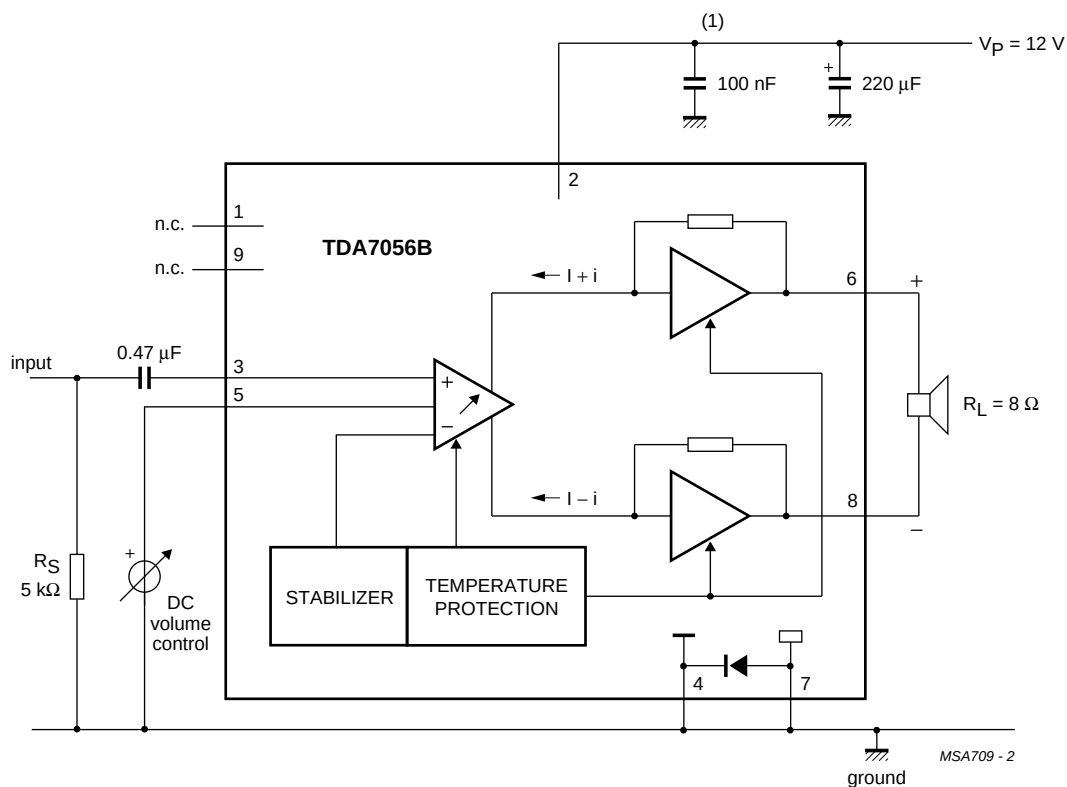
Measured at a THD of 1% and a voltage gain of 0 dB.

Fig.12 Input signal handling.

5 W mono BTL audio amplifier with DC volume control

TDA7056B

TEST AND APPLICATION INFORMATION



To avoid instabilities and too high distortion, the input- and power ground must be separated as long as possible and connected together as close as possible to the IC.

(1) This capacitor can be omitted if the 220 μF electrolytic capacitor is connected close to pin 2.

Fig.13 Test and application diagram.

For single-end application the output peak current may not exceed 100 mA; at higher output currents the short circuit protection (MLC) will be activated.

5 W mono BTL audio amplifier with DC
volume control

TDA7056B

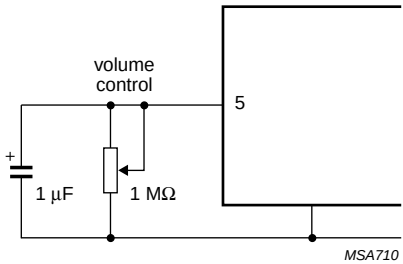


Fig.14 Application with potentiometer as volume control; maximum gain = 34 dB.

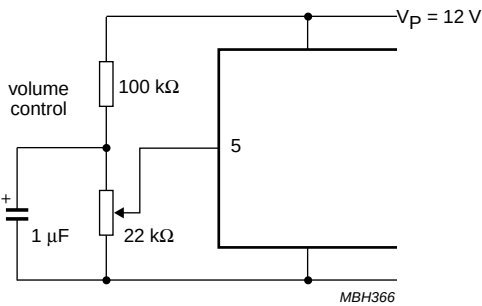


Fig.15 Application with potentiometer as volume control; maximum gain = 40 dB.

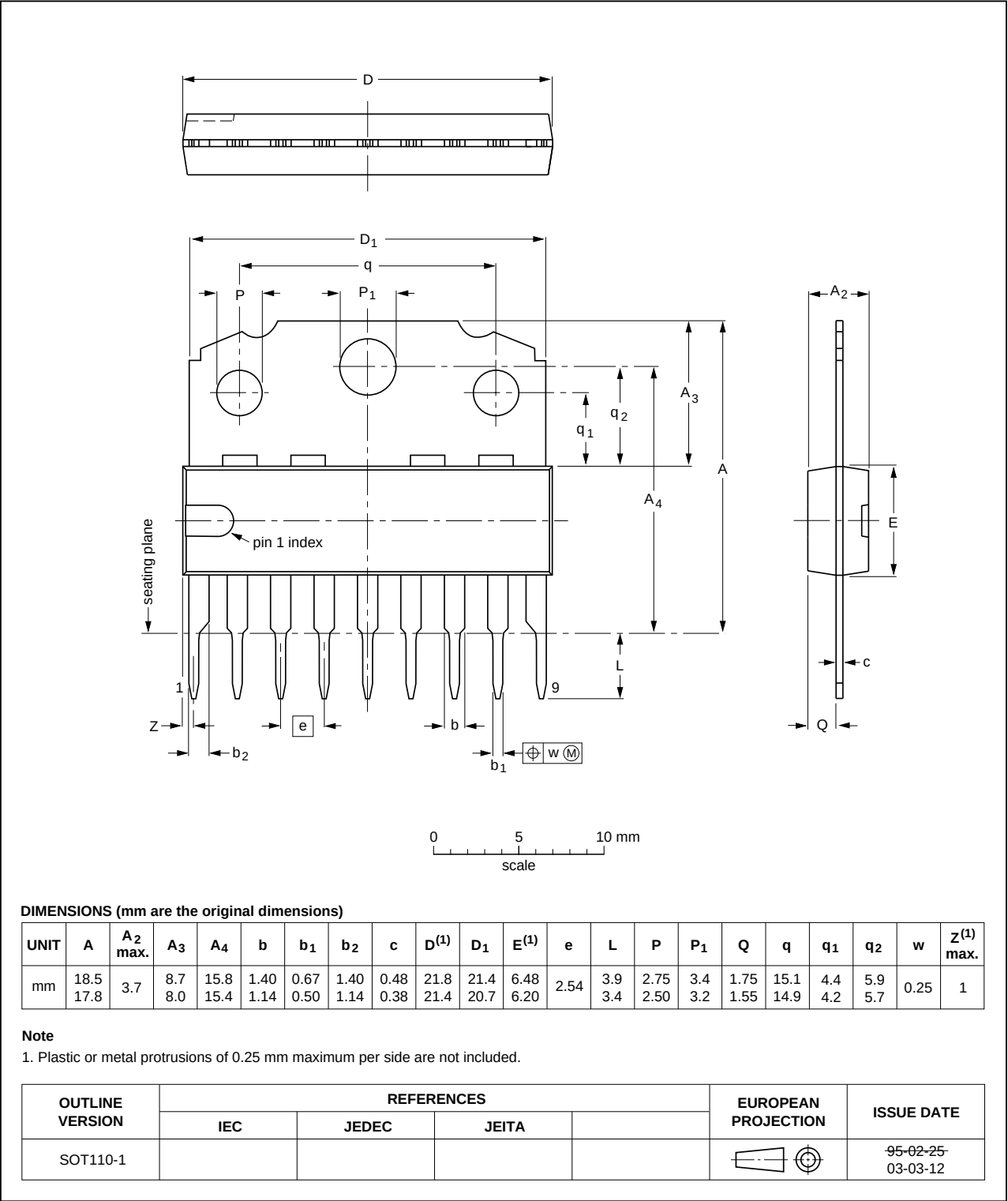
5 W mono BTL audio amplifier with DC volume control

TDA7056B

PACKAGE OUTLINE

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

SOT110-1



5 W mono BTL audio amplifier with DC volume control

TDA7056B

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.

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 ($T_{\text{stg max}}$). 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.

Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, 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.

5 W mono BTL audio amplifier with DC volume control

TDA7056B

DATA SHEET STATUS

DOCUMENT STATUS ⁽¹⁾	PRODUCT STATUS ⁽²⁾	DEFINITION
Objective data sheet	Development	This document contains data from the objective specification for product development.
Preliminary data sheet	Qualification	This document contains data from the preliminary specification.
Product data sheet	Production	This document contains the product specification.

Notes

1. Please consult the most recently issued document before initiating or completing a design.
2. The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

DEFINITIONS

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

DISCLAIMERS

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

5 W mono BTL audio amplifier with DC volume control

TDA7056B

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nxp.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from national authorities.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Non-automotive qualified products — Unless this data sheet expressly states that this specific NXP Semiconductors product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NXP Semiconductors accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NXP Semiconductors' warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NXP Semiconductors' specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NXP Semiconductors for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NXP Semiconductors' standard warranty and NXP Semiconductors' product specifications.

NXP Semiconductors

provides High Performance Mixed Signal and Standard Product solutions that leverage its leading RF, Analog, Power Management, Interface, Security and Digital Processing expertise

Customer notification

This data sheet was changed to reflect the new company name NXP Semiconductors, including new legal definitions and disclaimers. No changes were made to the technical content, except for package outline drawings which were updated to the latest version.

Contact information

For additional information please visit: <http://www.nxp.com>

For sales offices addresses send e-mail to: salesaddresses@nxp.com

© NXP B.V. 2011

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Printed in The Netherlands

RM5/03/pp15

Date of release: 1997 Aug 15