

# **DATA SHEET**

## **TDA7053A**

### **Stereo BTL audio output amplifier with DC volume control**

Product specification

1997 Jul 15

Supersedes data of 1995 Nov 09

File under Integrated Circuits, IC01

## Stereo BTL audio output amplifier with DC volume control

TDA7053A

### 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 TDA7053A ( $2 \times 1$  W) and TDA7053AT ( $2 \times 0.5$  W) are stereo BTL output amplifiers with DC volume control. The devices are designed for use in TV and monitors, but are also suitable for battery-fed portable recorders and radios.

#### Missing Current Limiter (MCL)

A MCL protection circuit is built-in. The MCL circuit is activated when the difference in current between the output terminal of each amplifier exceeds 100 mA (typical 300 mA). 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
$P_{out}$	output power TDA7053A TDA7053AT	$V_P = 6$ V $R_L = 8 \Omega$ $R_L = 16 \Omega$	0.85 0.5	1.0 0.55	— —	W W
$G_v$	voltage gain		39.5	40.5	41.5	dB
$G_C$	gain control		68.0	73.5	—	dB
$I_{q(tot)}$	total quiescent current	$V_P = 6$ V; $R_L = \infty$	—	22	25	mA
THD	total harmonic distortion TDA7053A TDA7053AT	$P_{out} = 0.5$ W $P_{out} = 0.25$ W	— —	0.3 0.3	1 1	% %

### ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA7053A	DIP16	plastic dual in-line package; 16 leads (300 mil); long body	SOT38-1
TDA7053AT	SO16	plastic small outline package; 16 leads; body width 7.5 mm	SOT162-1

# Stereo BTL audio output amplifier with DC volume control

TDA7053A

## BLOCK DIAGRAM

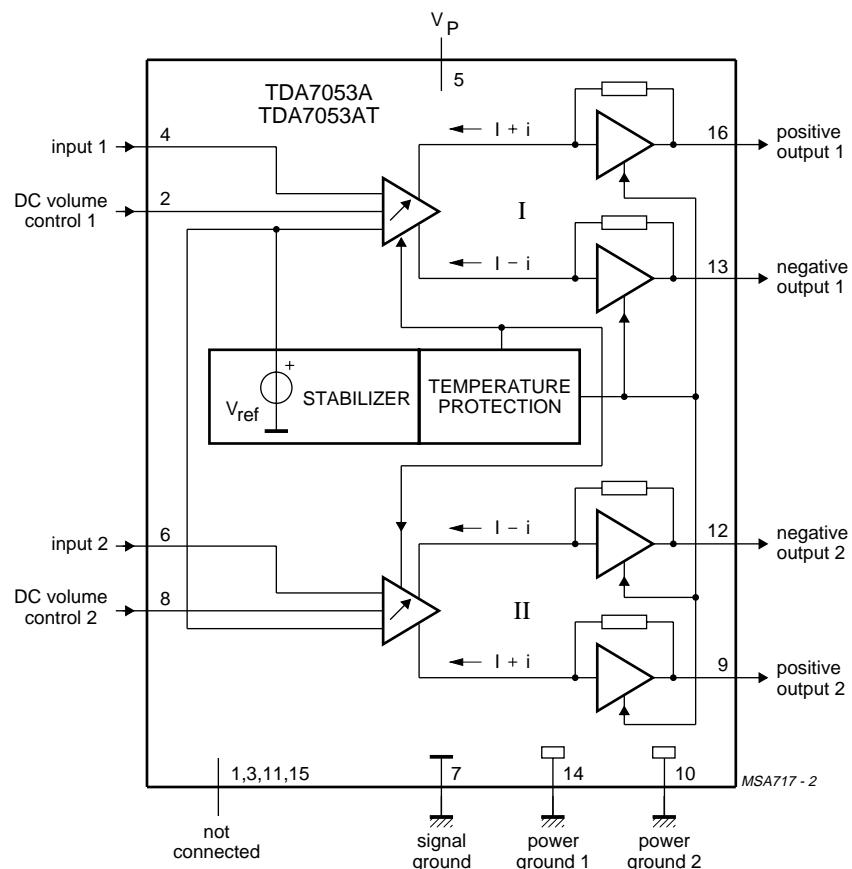


Fig.1 Block diagram.

## Stereo BTL audio output amplifier with DC volume control

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### PINNING

SYMBOL	PIN	DESCRIPTION
n.c.	1	not connected
VC1	2	DC volume control 1
n.c.	3	not connected
$V_I(1)$	4	voltage input 1
$V_P$	5	positive supply voltage
$V_I(2)$	6	voltage input 2
SGND	7	signal ground
VC2	8	DC volume control 2
OUT2+	9	positive output 2
PGND2	10	power ground 2
n.c.	11	not connected
OUT2-	12	negative output 2
OUT1-	13	negative output 1
PGND1	14	power ground 1
n.c.	15	not connected
OUT1+	16	positive output 1

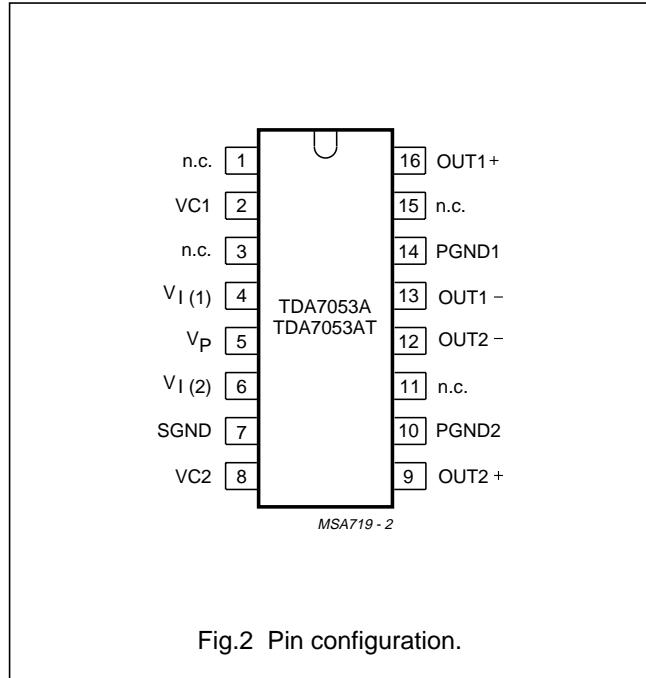


Fig.2 Pin configuration.

### FUNCTIONAL DESCRIPTION

The TDA7053A and TDA7053AT are stereo output amplifiers with two DC volume control stages, designed for TV and monitors, but also suitable for battery-fed portable recorders and radios.

In conventional DC volume control circuits the control or input stage is AC coupled to the output stage via external capacitors to keep the offset voltage low.

The two DC volume control stages are integrated into the input stages so that no coupling capacitors are required and a low offset voltage is still maintained. The minimum supply voltage also 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 stages have a logarithmic control characteristic. Therefore, the total gain can be controlled from +40.5 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 protected to ground,  $V_P$  and across the load. A thermal protection circuit is also 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.

# Stereo BTL audio output amplifier with DC volume control

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## LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_P$	supply voltage		–	18	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 TDA7053A TDA7053AT	$T_{amb} \leq 25^\circ\text{C}$	– –	2.5 1.32	W W
$t_{sc}$	short-circuit time		–	1	hr
$V_n$	input voltage pins 2, 4, 6 and 8		–	5	V
$T_{amb}$	operating ambient temperature		–40	+85	$^\circ\text{C}$
$T_{stg}$	storage temperature		–55	+150	$^\circ\text{C}$
$T_{vj}$	virtual junction temperature		–	+150	$^\circ\text{C}$

## THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient in free air TDA7053A TDA7053AT	50 95	K/W K/W

### Power dissipation

TDA7053A:

Assume  $V_P = 6\text{ V}$  and  $R_L = 8\ \Omega$ .

The maximum sine wave dissipation is  $2 \times 0.9\text{ W} = 1.8\text{ W}$ .

The  $R_{th\ j-a}$  of the package is 50 K/W therefore  $T_{amb(max)} = 150 - (50 \times 1.8) = 60\text{ }^\circ\text{C}$ .

TDA7053AT:

Assume  $V_P = 6\text{ V}$  and  $R_L = 16\ \Omega$ .

The maximum sine wave dissipation is  $2 \times 0.46\text{ W} = 0.92\text{ W}$ .

The  $R_{th\ j-a}$  of the package is 95 K/W therefore  $T_{amb(max)} = 150 - (95 \times 0.92) = 62.6\text{ }^\circ\text{C}$ .

# Stereo BTL audio output amplifier with DC volume control

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## CHARACTERISTICS

$V_P = 6 \text{ V}$ ;  $T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$ ;  $f_i = 1 \text{ kHz}$ ; TDA7053A:  $R_L = 8 \Omega$ ; TDA7053AT:  $R_L = 16 \Omega$ ; unless otherwise specified (see Fig.13).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_P$	supply voltage		4.5	—	18	V
$I_{q(\text{tot})}$	total quiescent current	$V_P = 6 \text{ V}$ ; $R_L = \infty$ ; note 1	—	22	25	mA

### Maximum gain; $V_{2,8} \geq 1.4 \text{ V}$

$P_{\text{out}}$	output power TDA7053A TDA7053AT	THD = 10%	1.0 0.5	1.1 0.55	— —	W W
THD	total harmonic distortion TDA7053A TDA7053AT	$P_{\text{out}} = 0.5 \text{ W}$ $P_{\text{out}} = 0.25 \text{ W}$	— —	0.3 0.3	1 1	% %
$G_V$	voltage gain		39.5	40.5	41.5	dB
$V_{I(\text{rms})}$	input signal handling (RMS value)	$G_V = 0 \text{ dB}$ ; THD < 1%	1	—	—	V
$V_{\text{no}}$	noise output voltage	$f_i = 500 \text{ kHz}$ ; note 2	—	210	—	$\mu\text{V}$
B	bandwidth	at $-1 \text{ dB}$	—	note 3	—	Hz
SVRR	supply voltage ripple rejection	note 4	34	38	—	dB
$V_{O(\text{os})}$	DC output offset voltage	$ V_{16} - V_{13} $ and $ V_{12} - V_9 $	—	0	200	mV
$Z_i$	input impedance (pins 4 and 6)		15	20	25	$\text{k}\Omega$
$\alpha_{\text{cs}}$	channel separation	$R_S = 5 \text{ k}\Omega$	40	—	—	dB
$ G_V $	channel unbalance	note 5	—	—	1	dB
		$G_1 = 0 \text{ dB}$ ; note 6	—	—	1	dB

### Mute position; $V_{2,8} = 0.4 \text{ V} \pm 30 \text{ mV}$

$V_O$	output voltage in mute position	$V_i = 1.0 \text{ V}$ ; note 7	—	30	40	$\mu\text{V}$
<b>DC volume control</b>						
$G_C$	gain control		68.5	73.5	—	dB
$I_{\text{DC}}$	volume control current	$V_2 = V_8 = 0 \text{ V}$	-20	-25	-30	$\mu\text{A}$

## 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  $f_i = 500 \text{ kHz}$  is measured with  $R_S = 0 \Omega$  and bandwidth = 5 kHz.
- 20 Hz to 300 kHz (typical).
- The ripple rejection is measured with  $R_S = 0 \Omega$  and  $f_i = 100 \text{ Hz}$  to 10 kHz. The ripple voltage of 200 mV (RMS value) is applied to the positive supply rail.
- The channel unbalance is measured with  $V_{DC1} = V_{DC2}$ .
- The channel unbalance at  $G_1 = 0 \text{ dB}$  is measured with  $V_{DC1} = V_{DC2}$ .
- The noise output voltage (RMS value) is measured with  $R_S = 5 \text{ k}\Omega$  unweighted.

## Stereo BTL audio output amplifier with DC volume control

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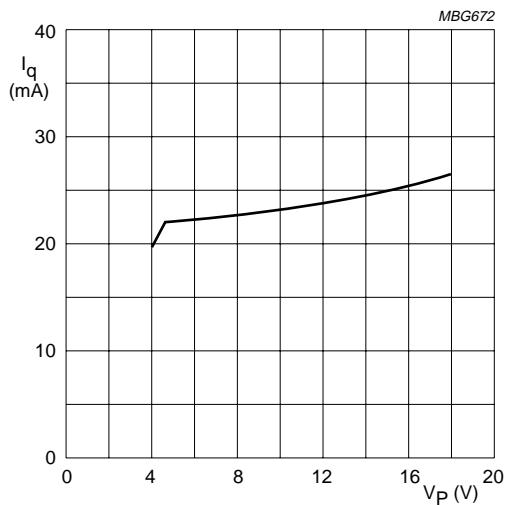


Fig.3 Quiescent current as a function of supply voltage.

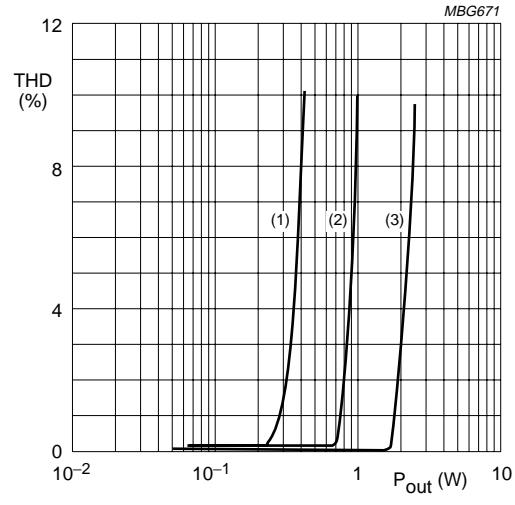


Fig.4 THD as a function of output power.

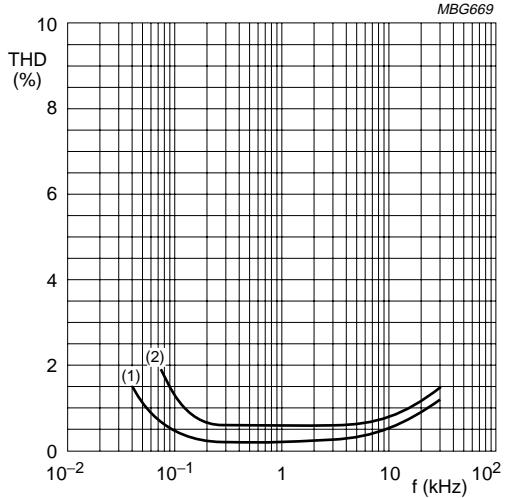


Fig.5 THD as a function of frequency.

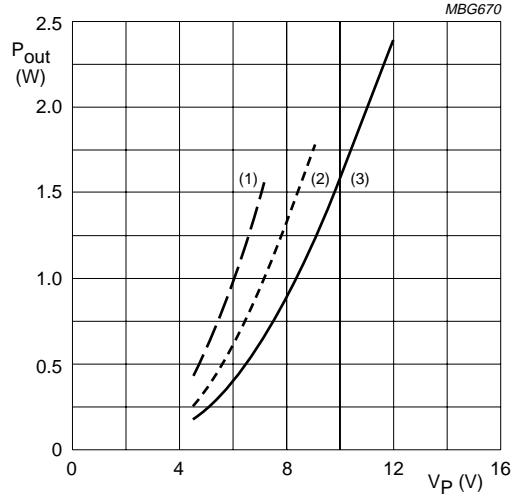
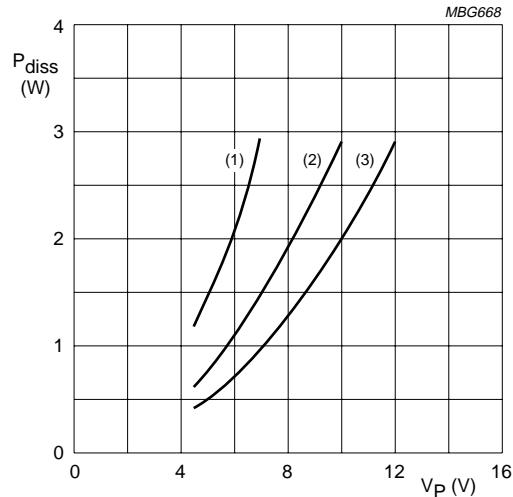


Fig.6 Output power as a function of supply voltage.

## Stereo BTL audio output amplifier with DC volume control

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- (1)  $R_L = 8 \Omega$ .
- (2)  $R_L = 16 \Omega$ .
- (3)  $R_L = 25 \Omega$ .

Fig.7 Total worst case power dissipation as a function of supply voltage.

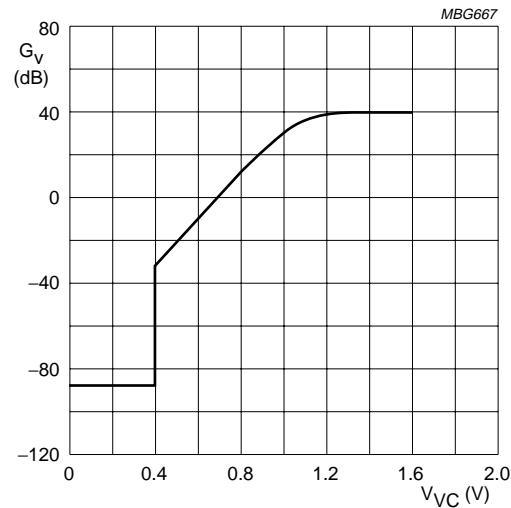
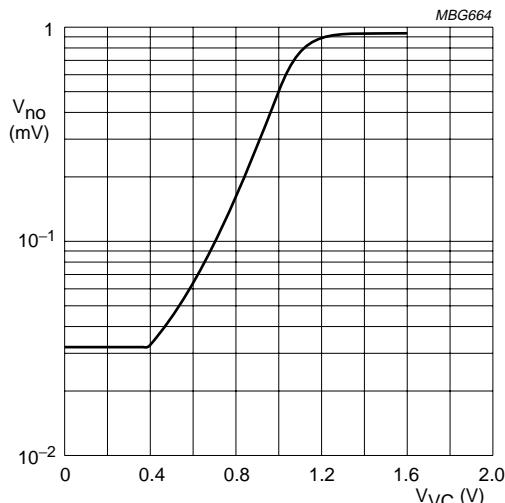
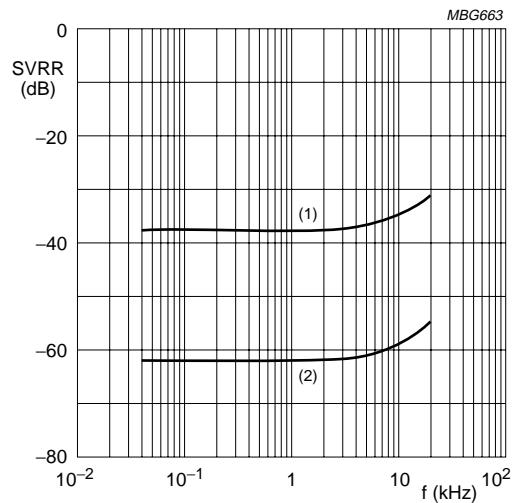


Fig.8 Voltage gain as a function of volume control voltage.



$f = 22 \text{ Hz to } 22 \text{ kHz.}$

Fig.9 Noise voltage as a function of volume control voltage.

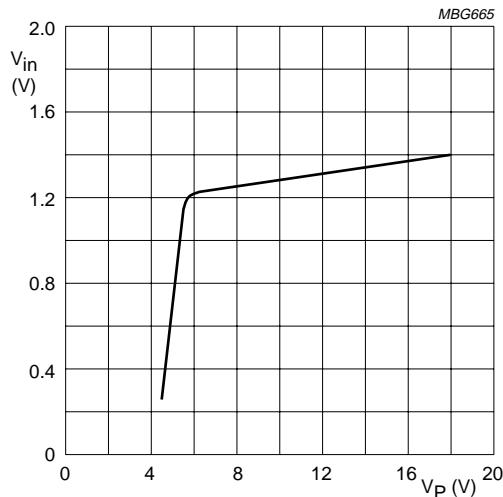


- (1)  $V_{DC} = 1.4 \text{ V}; V_{\text{ripple}} = 0.2 \text{ V.}$
- (2)  $V_{DC} = 0.4 \text{ V}; V_{\text{ripple}} = 0.2 \text{ V.}$

Fig.10 SVRR as a function of frequency.

## Stereo BTL audio output amplifier with DC volume control

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THD = 1 %.

Fig.11 Input signal handling.

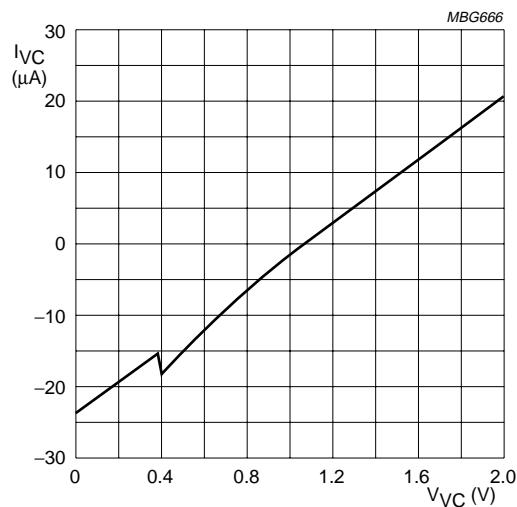


Fig.12 Volume control current as a function of volume control voltage.

## APPLICATION INFORMATION

The application diagram is illustrated in Fig.13.

### Test conditions

T<sub>amb</sub> = 25 °C unless otherwise specified; V<sub>P</sub> = 6 V; V<sub>DC</sub> = 1.4 V; f<sub>i</sub> = 1 kHz; R<sub>L</sub> = 8 Ω.

The quiescent current has been measured without load impedance.

The output power as a function of the supply voltage has been measured at THD = 10%. The maximum output power is limited by the maximum power dissipation and the maximum available output current.

The maximum input signal voltage is measured at THD = 1% at the output with a voltage gain of 0 dB.

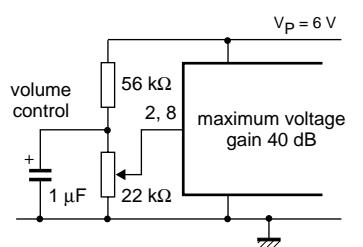
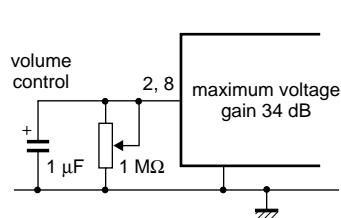
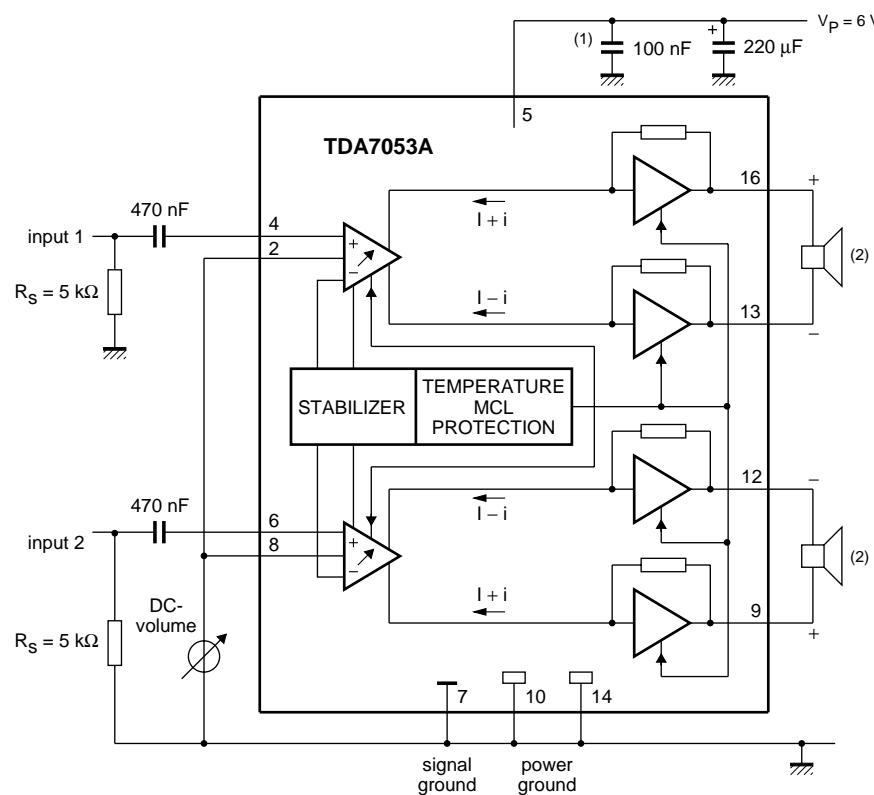
To avoid instabilities and too high distortion, the input ground and power ground must be separated as far as possible and connected as close as possible to the IC.

The DC volume control can be applied in several ways. Two possible circuits are shown below the main application diagram. The circuits at the control pin will influence the switch-on and switch-off behaviour and the maximum voltage gain.

For single-end applications the output peak current must not exceed 100 mA. At higher output currents the short-circuit protection (MCL) will be active.

# Stereo BTL audio output amplifier with DC volume control

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(1) This capacitor can be omitted if the  $220 \mu\text{F}$  electrolytic capacitor is connected close to pin 5.

(2)  $R_L = 8 \Omega$ .

Fig.13 Test and application diagram.

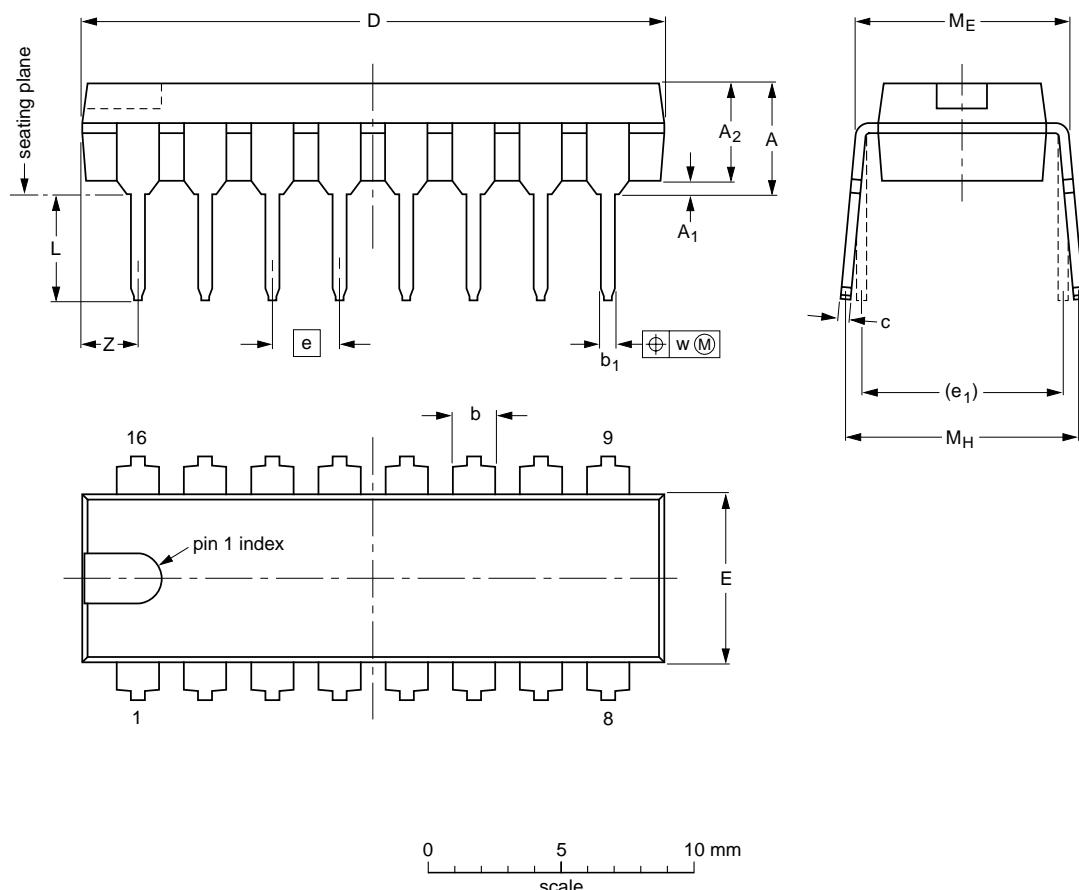
# Stereo BTL audio output amplifier with DC volume control

TDA7053A

## PACKAGE OUTLINES

DIP16: plastic dual in-line package; 16 leads (300 mil); long body

SOT38-1



### DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A <sub>1</sub> min.	A <sub>2</sub> max.	b	b <sub>1</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	e <sub>1</sub>	L	M <sub>E</sub>	M <sub>H</sub>	w	Z <sup>(1)</sup> max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	2.2
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.087

#### Note

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

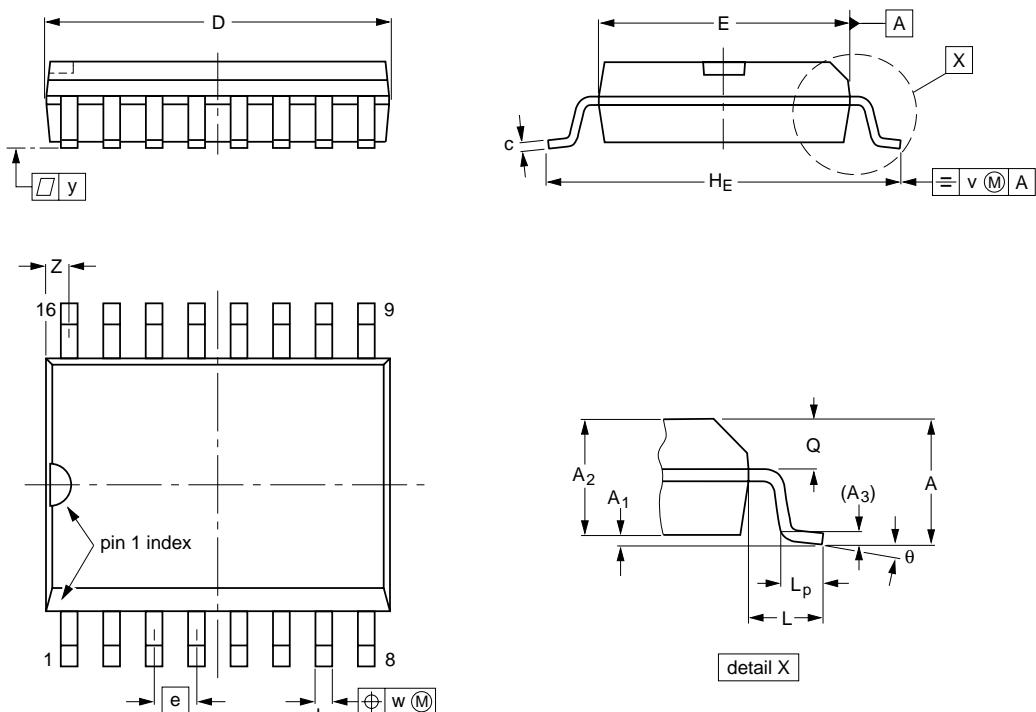
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-1	050G09	MO-001AE				-92-10-02- 95-01-19

# Stereo BTL audio output amplifier with DC volume control

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SO16: plastic small outline package; 16 leads; body width 7.5 mm

SOT162-1



## DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	z <sup>(1)</sup>	θ
mm	2.65 0.10	0.30 2.25	2.45	0.25	0.49 0.36	0.32 0.23	10.5 10.1	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10 0.004	0.012 0.089	0.096	0.01	0.019 0.014	0.013 0.009	0.41 0.40	0.30 0.29	0.050	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

## Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT162-1	075E03	MS-013AA				-95-01-24 97-05-22

# Stereo BTL audio output amplifier with DC volume control

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## 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).

### DIP

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

### SO

#### REFLOW SOLDERING

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

#### WAVE SOLDERING

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

#### REPAIRING SOLDERED JOINTS

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

## Stereo BTL audio output amplifier with DC volume control

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### DEFINITIONS

<b>Data sheet status</b>	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
<b>Limiting values</b>	
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.	
<b>Application information</b>	
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.

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Stereo BTL audio output amplifier with DC  
volume control

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TDA7053A

**NOTES**

# Philips Semiconductors – a worldwide company

**Argentina:** see South America

**Australia:** 34 Waterloo Road, NORTH RYDE, NSW 2113, Tel. +61 2 9805 4455, Fax. +61 2 9805 4466

**Austria:** Computerstr. 6, A-1101 WIEN, P.O. Box 213, Tel. +43 1 60 1010, Fax. +43 1 60 101 1210

**Belarus:** Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6, 220050 MINSK, Tel. +375 172 200 733, Fax. +375 172 200 773

**Belgium:** see The Netherlands

**Brazil:** see South America

**Bulgaria:** Philips Bulgaria Ltd., Energoproject, 15th floor, 51 James Bourchier Blvd., 1407 SOFIA, Tel. +359 2 689 211, Fax. +359 2 689 102

**Canada:** PHILIPS SEMICONDUCTORS/COMPONENTS, Tel. +1 800 234 7381

**China/Hong Kong:** 501 Hong Kong Industrial Technology Centre, 72 Tat Chee Avenue, Kowloon Tong, HONG KONG, Tel. +852 2319 7888, Fax. +852 2319 7700

**Colombia:** see South America

**Czech Republic:** see Austria

**Denmark:** Prags Boulevard 80, PB 1919, DK-2300 COPENHAGEN S, Tel. +45 32 88 2636, Fax. +45 31 57 0044

**Finland:** Sinikalliontie 3, FIN-02630 ESPOO, Tel. +358 9 615800, Fax. +358 9 61580920

**France:** 4 Rue du Port-aux-Vins, BP317, 92156 SURESNES Cedex, Tel. +33 1 40 99 6161, Fax. +33 1 40 99 6427

**Germany:** Hammerbrookstraße 69, D-20097 HAMBURG, Tel. +49 40 23 53 60, Fax. +49 40 23 536 300

**Greece:** No. 15, 25th March Street, GR 17778 TAVROS/ATHENS, Tel. +30 1 4894 339/239, Fax. +30 1 4814 240

**Hungary:** see Austria

**India:** Philips INDIA Ltd, Band Box Building, 2nd floor, 254-D, Dr. Annie Besant Road, Worli, MUMBAI 400 025, Tel. +91 22 493 8541, Fax. +91 22 493 0966

**Indonesia:** see Singapore

**Ireland:** Newstead, Clonskeagh, DUBLIN 14, Tel. +353 1 7640 000, Fax. +353 1 7640 200

**Israel:** RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053, TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

**Italy:** PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3, 20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

**Japan:** Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108, Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

**Korea:** Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL, Tel. +82 2 709 1412, Fax. +82 2 709 1415

**Malaysia:** No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR, Tel. +60 3 750 5214, Fax. +60 3 757 4880

**Mexico:** 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905, Tel. +9-5 800 234 7381

**Middle East:** see Italy

**Netherlands:** Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB, Tel. +31 40 27 82785, Fax. +31 40 27 88399

**New Zealand:** 2 Wagener Place, C.P.O. Box 1041, AUCKLAND, Tel. +64 9 849 4160, Fax. +64 9 849 7811

**Norway:** Box 1, Manglerud 0612, OSLO, Tel. +47 22 74 8000, Fax. +47 22 74 8341

**Philippines:** Philips Semiconductors Philippines Inc., 106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI, Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

**Poland:** Ul. Lukiska 10, PL 04-123 WARSZAWA, Tel. +48 22 612 2831, Fax. +48 22 612 2327

**Portugal:** see Spain

**Romania:** see Italy

**Russia:** Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW, Tel. +7 095 755 6918, Fax. +7 095 755 6919

**Singapore:** Lorong 1, Toa Payoh, SINGAPORE 1231, Tel. +65 350 2538, Fax. +65 251 6500

**Slovakia:** see Austria

**Slovenia:** see Italy

**South Africa:** S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale, 2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000, Tel. +27 11 470 5911, Fax. +27 11 470 5494

**South America:** Rua do Rocio 220, 5th floor, Suite 51, 04552-903 São Paulo, SÃO PAULO - SP, Brazil, Tel. +55 11 821 2333, Fax. +55 11 829 1849

**Spain:** Balmes 22, 08007 BARCELONA, Tel. +34 3 301 6312, Fax. +34 3 301 4107

**Sweden:** Kottbygatan 7, Akalla, S-16485 STOCKHOLM, Tel. +46 8 632 2000, Fax. +46 8 632 2745

**Switzerland:** Allmendstrasse 140, CH-8027 ZÜRICH, Tel. +41 1 488 2686, Fax. +41 1 481 7730

**Taiwan:** Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1, TAIPEI, Taiwan Tel. +886 2 2134 2865, Fax. +886 2 2134 2874

**Thailand:** PHILIPS ELECTRONICS (THAILAND) Ltd., 209/2 Sanpavut-Bangna Road Prakanong, BANGKOK 10260, Tel. +66 2 745 4090, Fax. +66 2 398 0793

**Turkey:** Talatpasa Cad. No. 5, 80640 GÜLTEPE/İSTANBUL, Tel. +90 212 279 2770, Fax. +90 212 282 6707

**Ukraine:** PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7, 252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

**United Kingdom:** Philips Semiconductors Ltd., 276 Bath Road, Hayes, MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

**United States:** 811 East Arques Avenue, SUNNYVALE, CA 94088-3409, Tel. +1 800 234 7381

**Uruguay:** see South America

**Vietnam:** see Singapore

**Yugoslavia:** PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD, Tel. +381 11 625 344, Fax. +381 11 635 777

**For all other countries apply to:** Philips Semiconductors, Marketing & Sales Communications, Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

**Internet:** <http://www.semiconductors.philips.com>

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