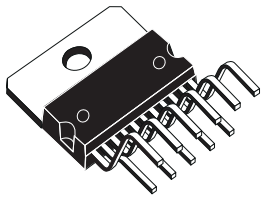
# TDA2009A

## 10 +10W STEREO AMPLIFIER

- HIGH OUTPUT POWER (10 + 10W Min. @ D = 1%)
- HIGH CURRENT CAPABILITY (UP TO 3.5A)
- AC SHORT CIRCUIT PROTECTION
- THERMAL OVERLOAD PROTECTION
- SPACE AND COST SAVING : VERY LOW NUMBER OF EXTERNAL COMPONENTS AND SIMPLE MOUNTING THANKS TO THE MULTIWATT ® PACKAGE.



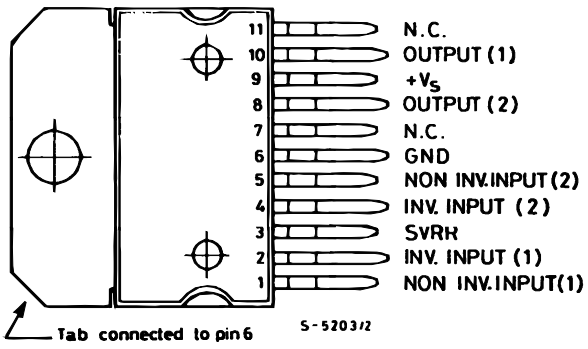
**MULTIWATT11**

**ORDERING NUMBER :** TDA2009A

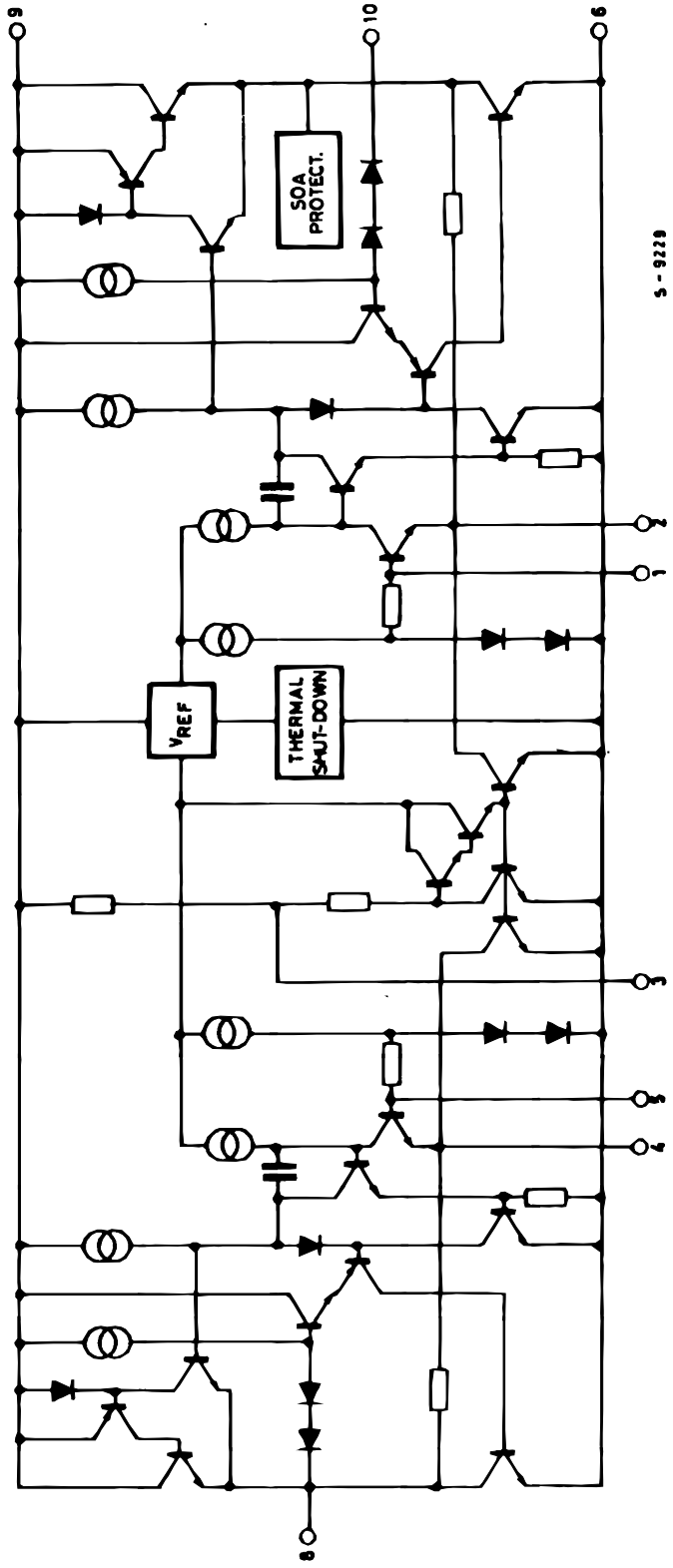
### DESCRIPTION

The TDA2009A is class AB dual Hi-Fi Audio power amplifier assembled in Multiwatt ® package, specially designed for high quality stereo application as Hi-Fi and music centers.

### PIN CONNECTION



## SCHEMATIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_s$ | Supply Voltage | 28 | V |
| $I_o$ | Output Peak Current (repetitive f ≥ 20 Hz) | 3.5 | A |
| $I_o$ | Output Peak Current (non repetitive, t = 100 µs) | 4.5 | A |
| $P_{tot}$ | Power Dissipation at $T_{case}$ = 90 °C | 20 | W |
| $T_{stg}$, $T_j$ | Storage and Junction Temperature | – 40, + 150 | °C |

## THERMAL DATA

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{th\ j\text{-}case}$ | Thermal Resistance Junction-case Max. | 3 | °C/W |

## ELECTRICAL CHARACTERISTICS

(refer to the stereo application circuit, $T_{amb}$ = 25°C, $V_S$ = 24V, $G_V$ = 36dB, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_s$ | Supply Voltage | | 8 | | 28 | V |
| $V_o$ | Quiescent Output Voltage | $V_s$ = 24V | | 11.5 | | V |
| $I_d$ | Total Quiescent Drain Current | $V_s$ = 24V | | 60 | 120 | mA |
| $P_o$ | Output Power (each channel) | d = 1%, $V_s$ = 24V, f = 1kHz<br>$R_L$ = 4Ω<br>$R_L$ = 8Ω<br>f = 40Hz to 12.5kHz<br>$R_L$ = 4Ω<br>$R_L$ = 8Ω<br>$V_s$ = 18V, f = 1kHz<br>$R_L$ = 4Ω<br>$R_L$ = 8Ω | <br><br><br><br>10<br>5<br><br><br> | <br>12.5<br>7<br><br><br><br>7<br>4 | <br><br><br><br><br><br><br><br> | <br>W<br>W<br><br>W<br>W<br><br>W<br>W |
| d | Distortion (each channel) | f = 1kHz, $V_s$ = 24V<br>$P_o$ = 0.1 to 7W $R_L$ = 4Ω<br>$P_o$ = 0.1 to 3.5W $R_L$ = 8Ω<br>$V_s$ = 18V<br>$P_o$ = 0.1 to 5W $R_L$ = 4 Ω<br>$P_o$ = 0.1 to 2.5W $R_L$ = 8Ω | | <br>0.2<br>0.1<br><br>0.2<br>0.1 | | <br>%<br>%<br><br>%<br>% |
| CT | Cross Talk (3) | $R_L$ = ∞, $R_g$ = 10kΩ<br>f = 1kHz<br>f = 10kHz | | <br>60<br>50 | | dB |
| $V_i$ | Input Saturation Voltage (rms) | | 300 | | | mV |
| $R_i$ | Input Resistance | f = 1kHz, Non Inverting Input | 70 | 200 | | kΩ |
| $f_L$ | Low Frequency Roll off (– 3dB) | $R_L$ = 4Ω | | 20 | | Hz |
| $f_H$ | High Frequency Roll off (– 3dB) | $R_L$ = 4Ω | | 80 | | kHz |
| $G_v$ | Voltage Gain (closed loop) | f = 1kHz | 35.5 | 36 | 36.5 | dB |
| $\Delta G_v$ | Closed Loop Gain Matching | | | 0.5 | | dB |
| $e_N$ | Total Input Noise Voltage | $R_g$ = 10kΩ (1)<br>$R_g$ = 10kΩ (2) | | 1.5<br>2.5 | <br>8 | µV<br>µV |
| SVR | Supply Voltage Rejection (each channel) | $R_g$ = 10kΩ<br>$f_{ripple}$ = 100Hz, $V_{ripple}$ = 0.5V | | 55 | | dB |
| $T_J$ | Thermal Shut-down Junction Temperature | | | 145 | | °C |

**Notes :** 1. Curve A
2. 22Hz to 22kHz

**Figure 1 :** Test and Application Circuit ($G_V$ = 36dB)

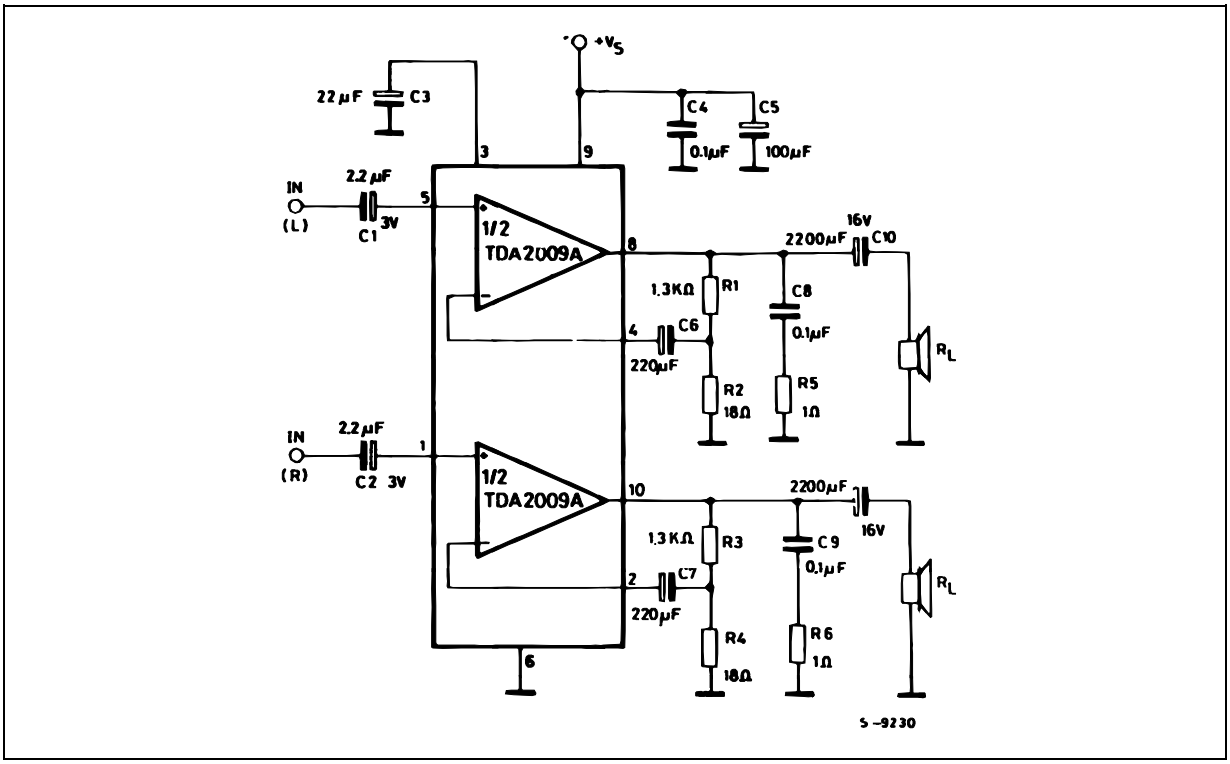



**Figure 2 :** P.C. board and component layout of the fig. 1

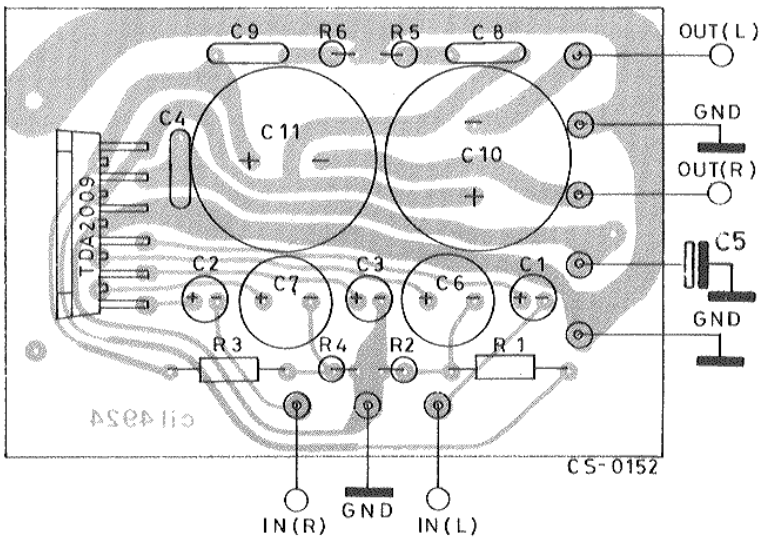


**Figure 3 :** Output Power versus Supply Voltage

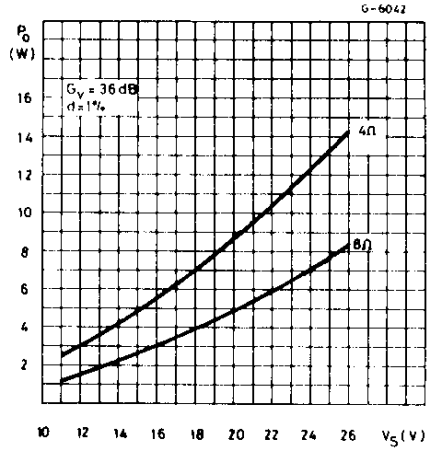



**Figure 4 :** Output Power versus Supply Voltage

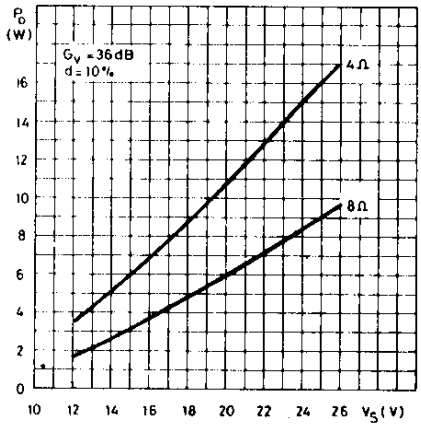



**Figure 5 :** Distortion versus Output Power

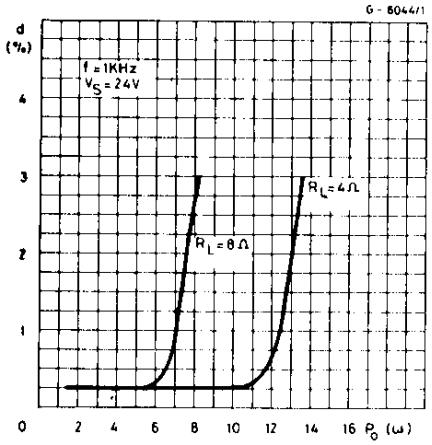



**Figure 6 :** Distortion versus Frequency

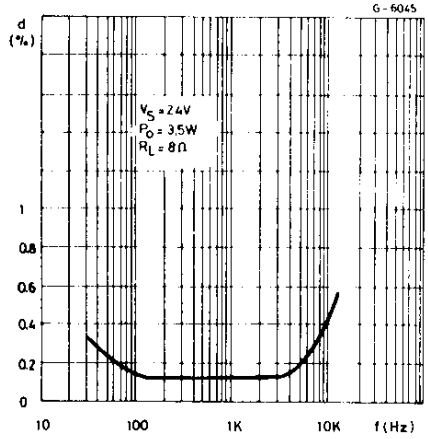



**Figure 7 :** Distortion versus Frequency

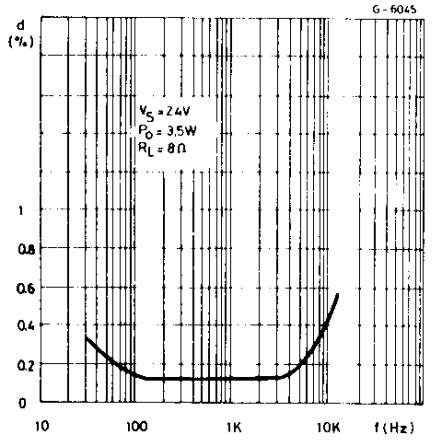



**Figure 8 :** Quiescent Current versus Supply Voltage

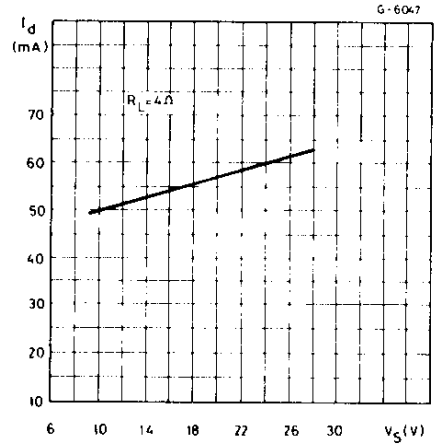


**Figure 9 :** Supply Voltage Rejection versus Frequency

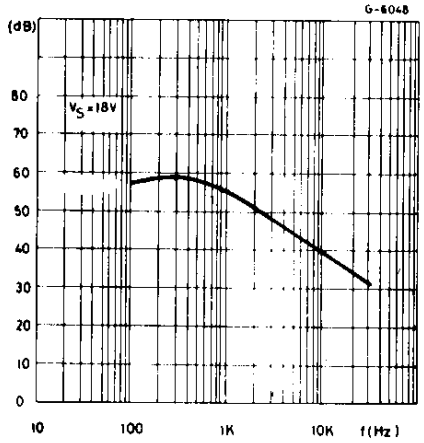



**Figure 10 :** Total Power Dissipation and Efficiency versus Output Power

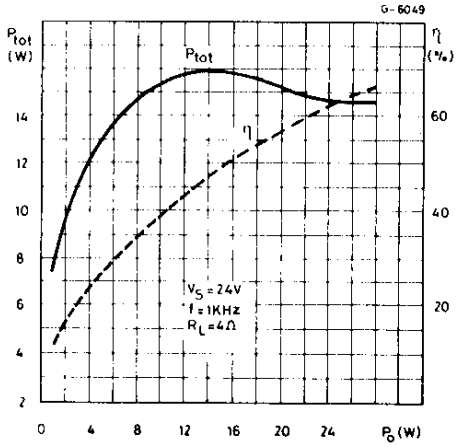
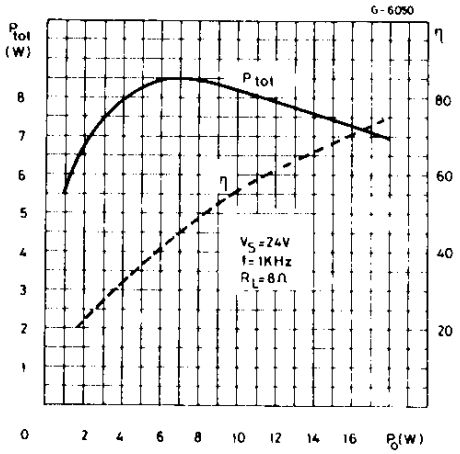



**Figure 11 :** Total Power Dissipation and Efficiency versus Output Power




## APPLICATION INFORMATION

**Figure 12 :** Example of Muting Circuit

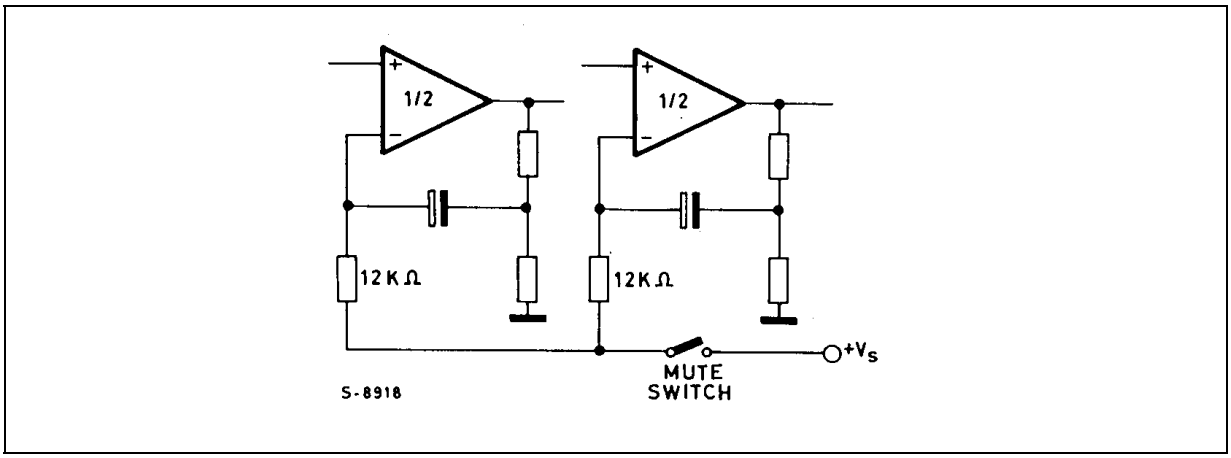


**Figure 13 :** 10W +10W Stereo Amplifier with Tone Balance and Loudness Control

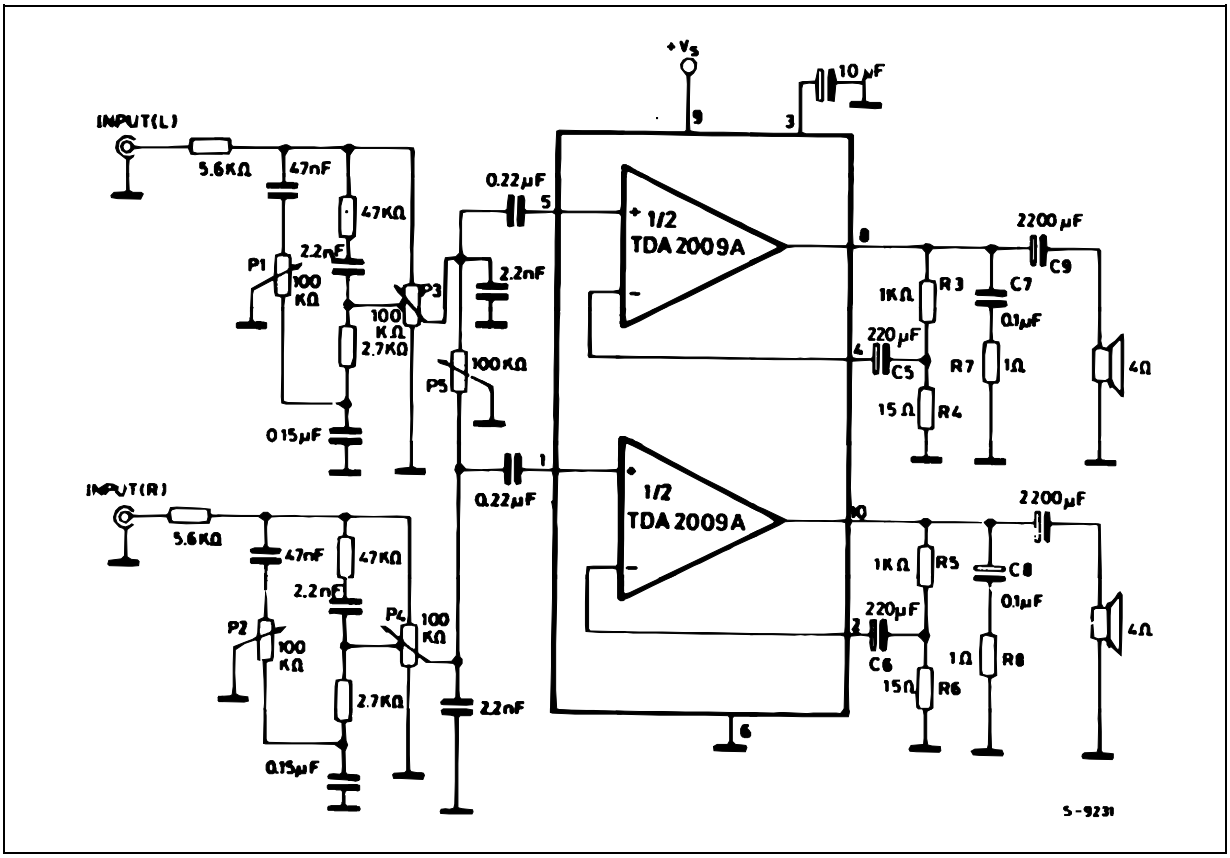



**Figure 14 :** Tone Control Response
(circuit of Figure 13)

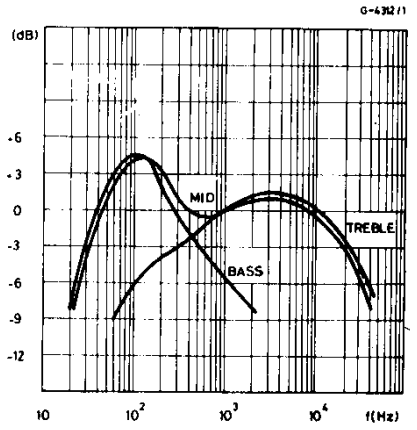


**Figure 15 :** High Quality 20 + 20W Two Way Amplifier for Stereo Music Center (one channel only)

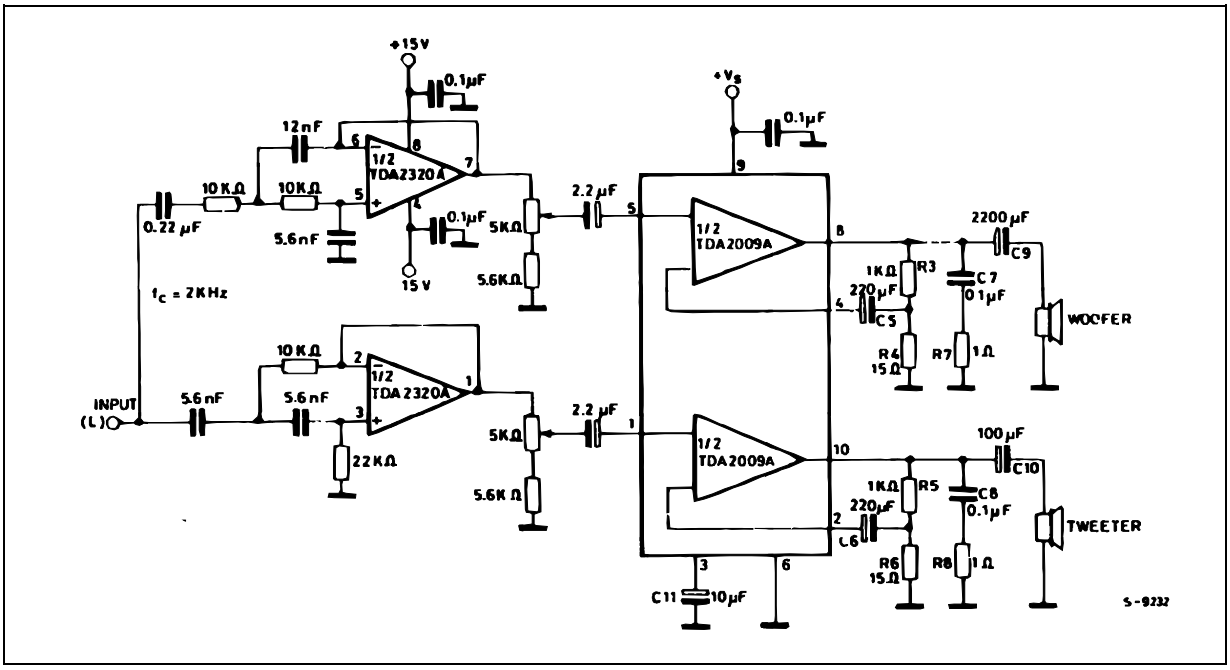



**Figure 16 :** 18W Bridge Amplifier (d = 1%, $G_V$ = 40dB)

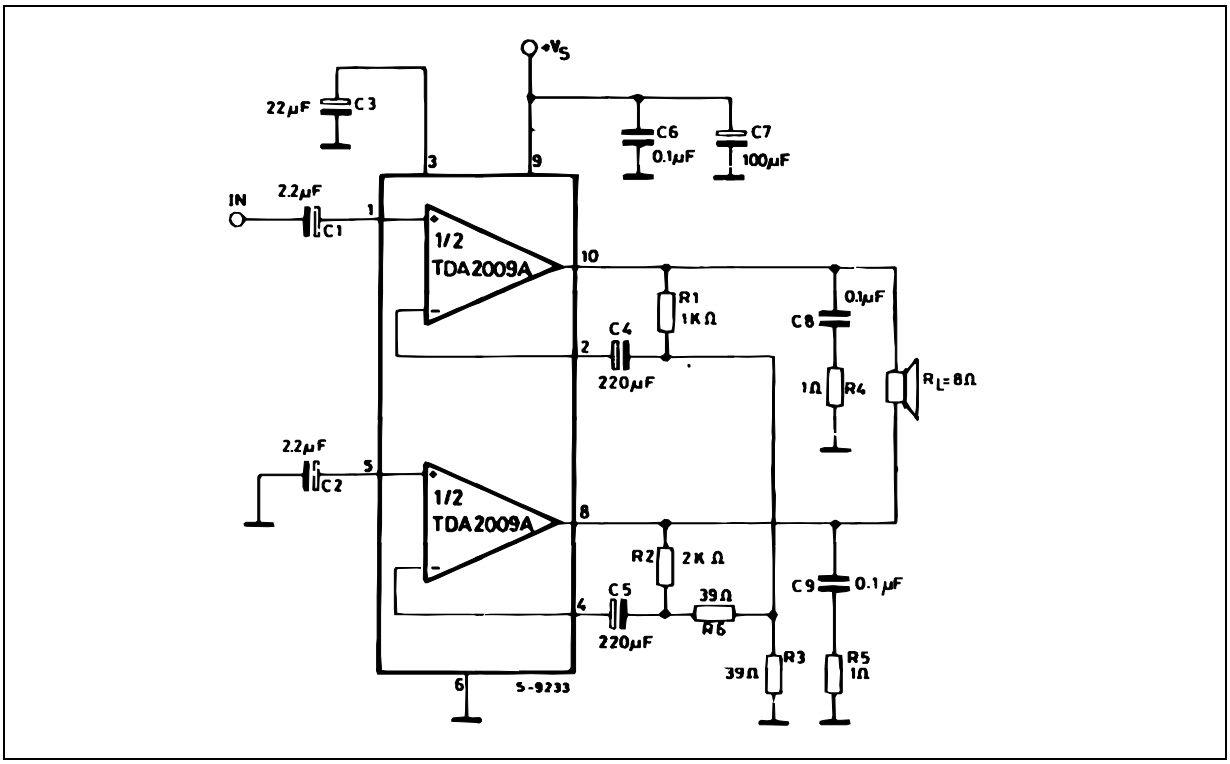
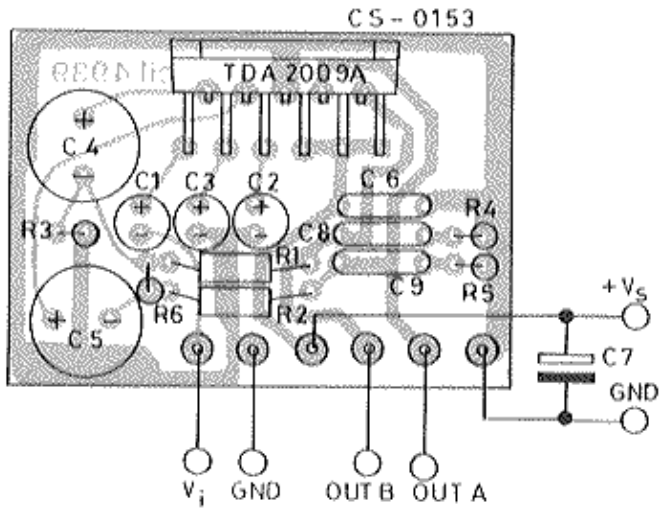


**Figure 17 :** P.C. BOARD and Components Layout of the Circuit of Figure 16 (1:1 scale)




## APPLICATION SUGGESTION

The recommended values of the components are those shown on application circuit of fig. 1. Different values can be used ; the following table can help the designer.

| Component | Recommended Value | Purpose | Larger than | Smaller than |
|---|---|---|---|---|
| R1, R3 | 1.2kΩ | Close Loop Gain Setting (1) | Increase of Gain | Decrease of Gain |
| R2, R4 | 18kΩ | | Decrease of Gain | Increase of Gain |
| R5, R6 | 1Ω | Frequency Stability | Danger of Oscillation at High Frequency with Inductive Load | |
| C1, C2 | 2.2µF | Input DC Decoupling | High Turn-on Delay | High Turn-on Pop. Higher Low Frequency Cut-off. Increase of Noise |
| C3 | 22µF | Ripple Rejection | Better SVR. Increase of the Switch-on Time | Degradation of SVR |
| C6, C7 | 220µF | Feedback Input DC Decoupling | | |
| C8, C9 | 0.1µF | Frenquency Stability | | Danger of Oscillation |
| C10, C11 | 1000µF to 2200µF | Output DC Decoupling | | Higher Low-frequency Cut-off |

(1) The closed loop gain must be higher than 26dB.

## BUILD-IN PROTECTION SYSTEMS

THERMAL SHUT-DOWN

The presence of a thermal limiting circuit offers the following advantages:

1) an averload on the output (even if it is permanent), or an excessive ambient temperature can be easily withstood.
2) the heatsink can have a smaller factor of safety compared with that of a conventional circuit. There is no device damage in the case of excessive junction temperature : all that happens is that $P_o$ (and therefore $P_{tot}$) and $I_o$ are reduced.

The maximum allowable power dissipation depends upon the size of the external heatsink (i.e. its thermal resistance); Figure 18 shows this dissipable power as a function of ambient temperature for different thermal resistance.

Short circuit (AC Conditions). The TDA2009A can withstand an accidental short circuit from the output and ground made by a wrong connection during normal play operation.

## MOUNTING INSTRUCTIONS

The power dissipated in the circuit must be removed by adding an external heatsink.

Thanks to the MULTIWATT ® package attaching the heatsink is very simple, a screw or a compression spring (clip) being sufficient. Between the heatsink and the package it is better to insert a layer of silicon grease, to optimize the thermal contact ; no electrical isolation is needed between the two

**Figure 18 :** Maximum Allowable Power Dissipation versus Ambient Temperature

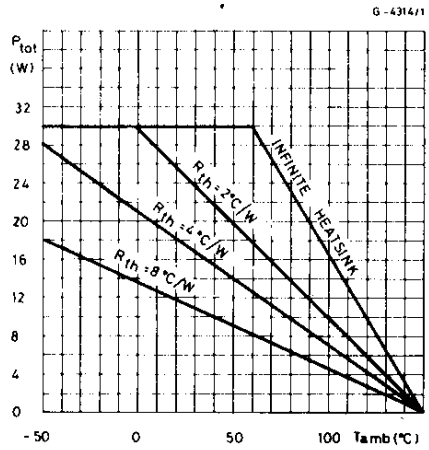



**Figure 19 :** Output Power versus Case Temperature

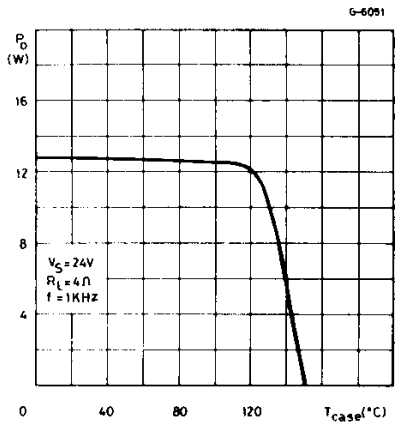
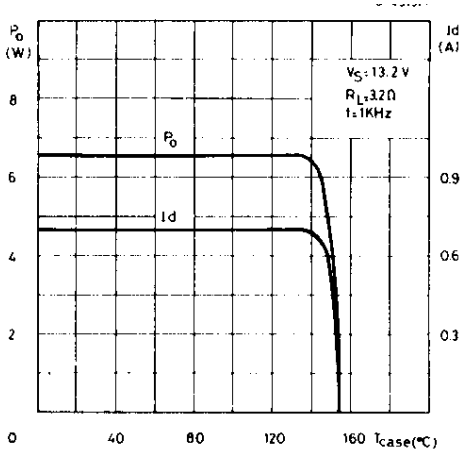
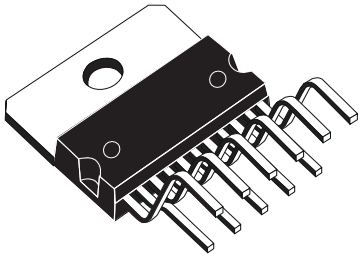



**Figure 20 :** Output Power and Drain Current versus Case Temperature

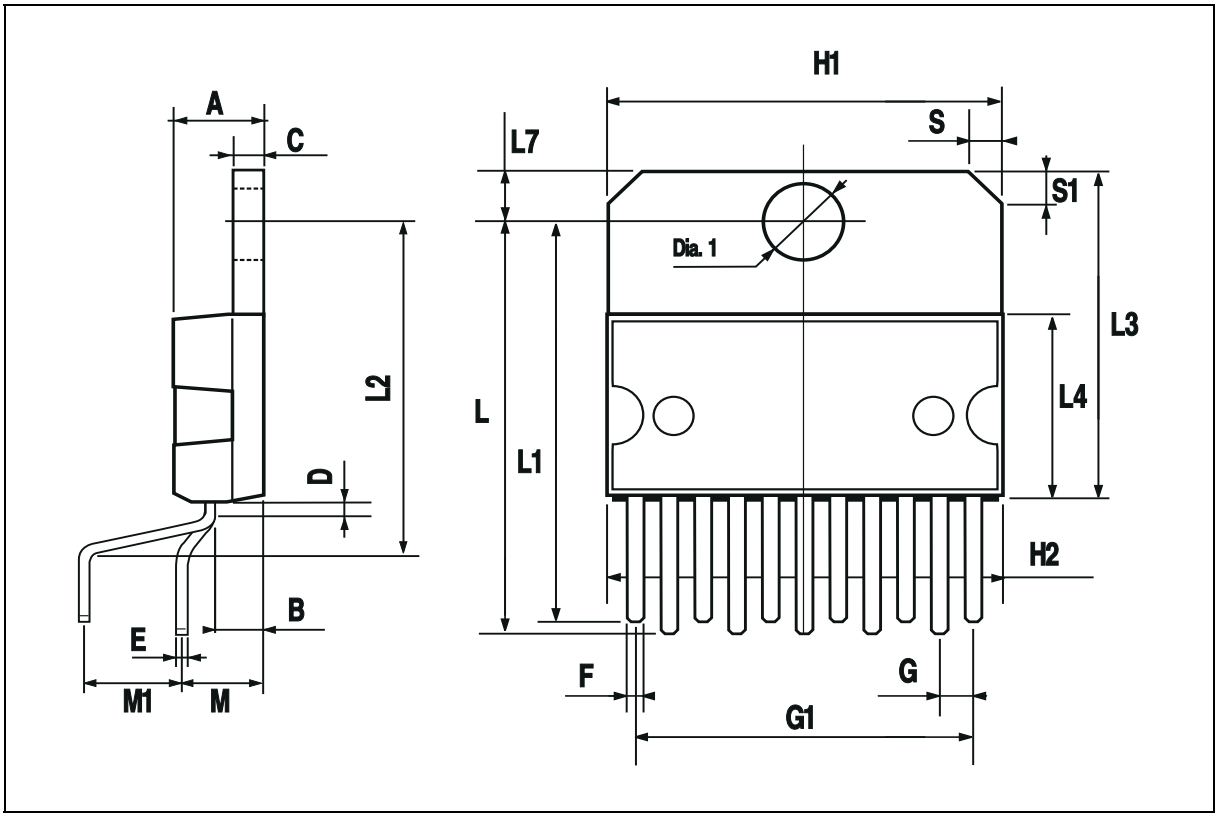


| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 5 | | | 0.197 |
| B | | | 2.65 | | | 0.104 |
| C | | | 1.6 | | | 0.063 |
| D | | 1 | | | 0.039 | |
| E | 0.49 | | 0.55 | 0.019 | | 0.022 |
| F | 0.88 | | 0.95 | 0.035 | | 0.037 |
| G | 1.45 | 1.7 | 1.95 | 0.057 | 0.067 | 0.077 |
| G1 | 16.75 | 17 | 17.25 | 0.659 | 0.669 | 0.679 |
| H1 | 19.6 | | | 0.772 | | |
| H2 | | | 20.2 | | | 0.795 |
| L | 21.9 | 22.2 | 22.5 | 0.862 | 0.874 | 0.886 |
| L1 | 21.7 | 22.1 | 22.5 | 0.854 | 0.87 | 0.886 |
| L2 | 17.4 | | 18.1 | 0.685 | | 0.713 |
| L3 | 17.25 | 17.5 | 17.75 | 0.679 | 0.689 | 0.699 |
| L4 | 10.3 | 10.7 | 10.9 | 0.406 | 0.421 | 0.429 |
| L7 | 2.65 | | 2.9 | 0.104 | | 0.114 |
| M | 4.25 | 4.55 | 4.85 | 0.167 | 0.179 | 0.191 |
| M1 | 4.73 | 5.08 | 5.43 | 0.186 | 0.200 | 0.214 |
| S | 1.9 | | 2.6 | 0.075 | | 0.102 |
| S1 | 1.9 | | 2.6 | 0.075 | | 0.102 |
| Dia1 | 3.65 | | 3.85 | 0.144 | | 0.152 |

## OUTLINE AND MECHANICAL DATA



**Multiwatt11 V**



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