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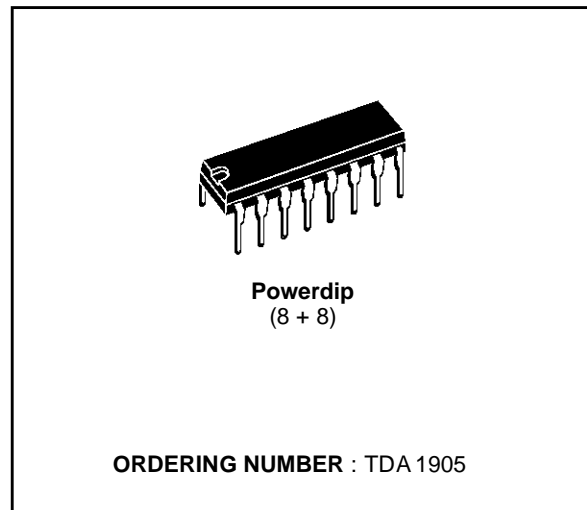
5W AUDIO AMPLIFIER WITH MUTING

DESCRIPTION

The TDA1905 is a monolithic integrated circuit in POWERDIP package, intended for use as low frequency power amplifier in a wide range of applications in radio and TV sets:

- muting facility
- protection against chip over temperature
- very low noise
- high supply voltage rejection
- low "switch-on" noise
- voltage range 4V to 30V

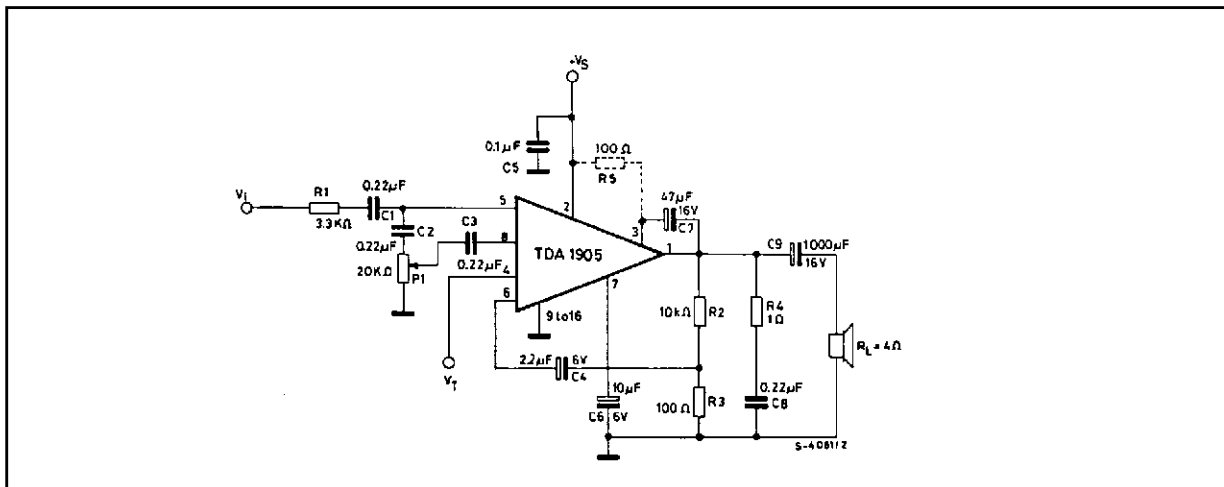
The TDA 1905 is assembled in a new plastic package, the POWERDIP, that offers the same assembly ease, space and cost saving of a normal dual in-line package but with a power dissipation of up to 6W and a thermal resistance of 15°C/W (junction to pins).



ABSOLUTE MAXIMUM RATINGS

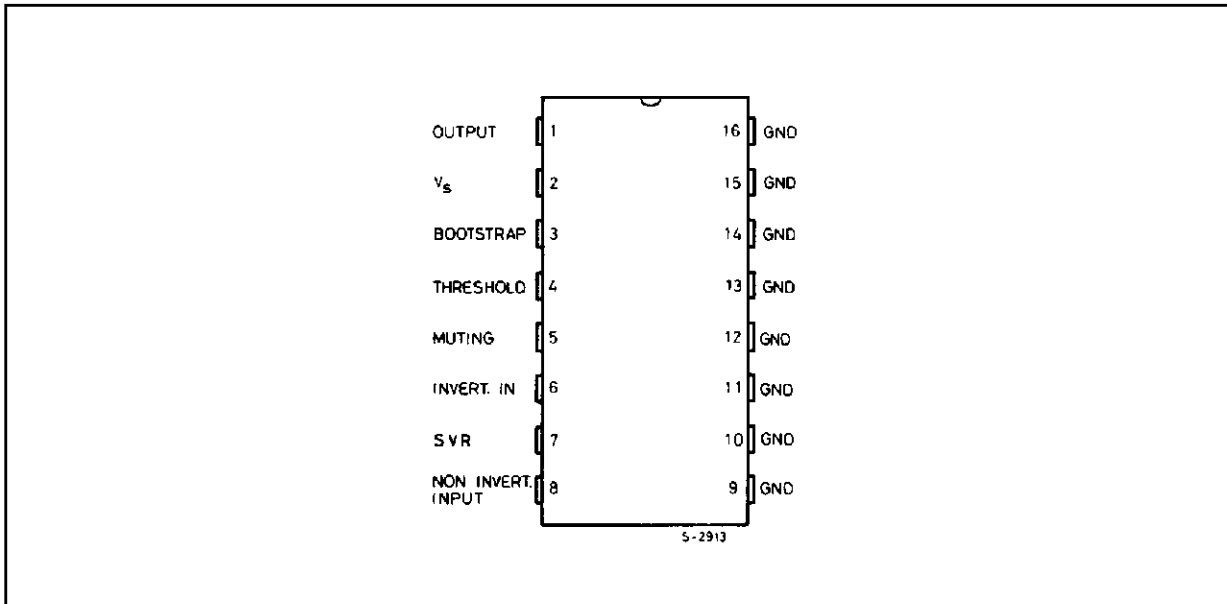
| Symbol | Parameter | Value | Unit |
|----------------|---|--------------|------------------|
| V_s | Supply voltage | 30 | V |
| I_o | Output peak current (non repetitive) | 3 | A |
| I_o | Output peak current (repetitive) | 2.5 | A |
| V_i | Input voltage | 0 to + V_s | V |
| V_i | Differential input voltage | ± 7 | V |
| V_{11} | Muting threshold voltage | V_s | V |
| P_{tot} | Power dissipation at $T_{amb} = 80^\circ\text{C}$ | 1 | W |
| | $T_{case} = 60^\circ\text{C}$ | 6 | W |
| T_{stg}, T_j | Storage and junction temperature | -40 to 150 | $^\circ\text{C}$ |

APPLICATION CIRCUIT

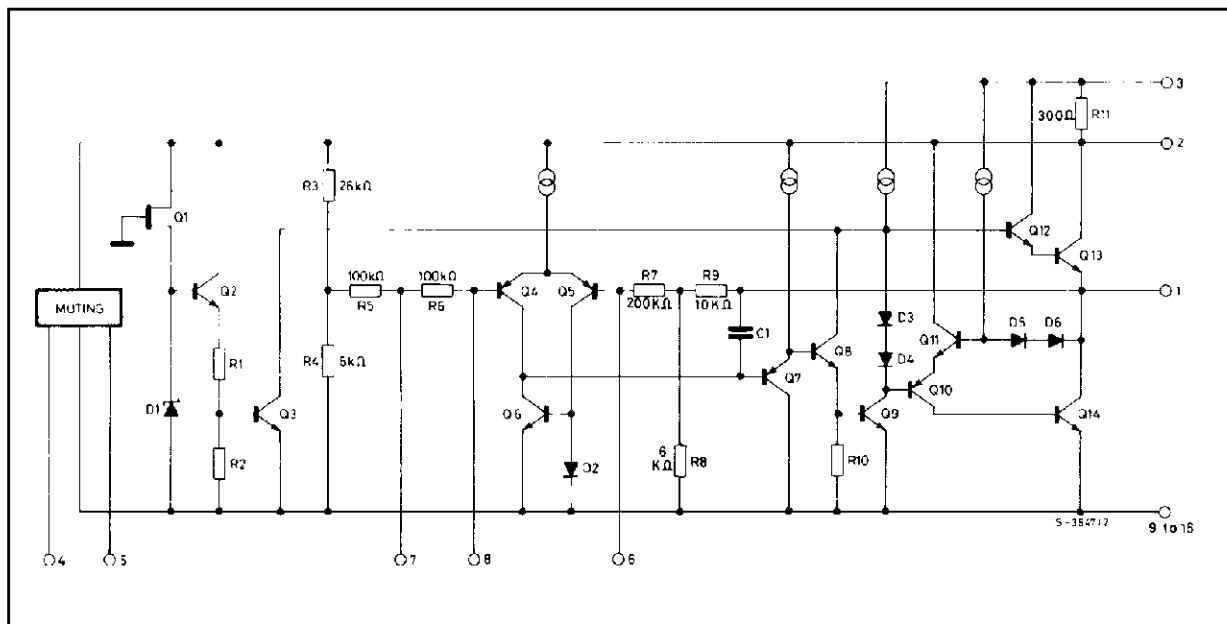


TDA1905

PIN CONNECTION (top view)



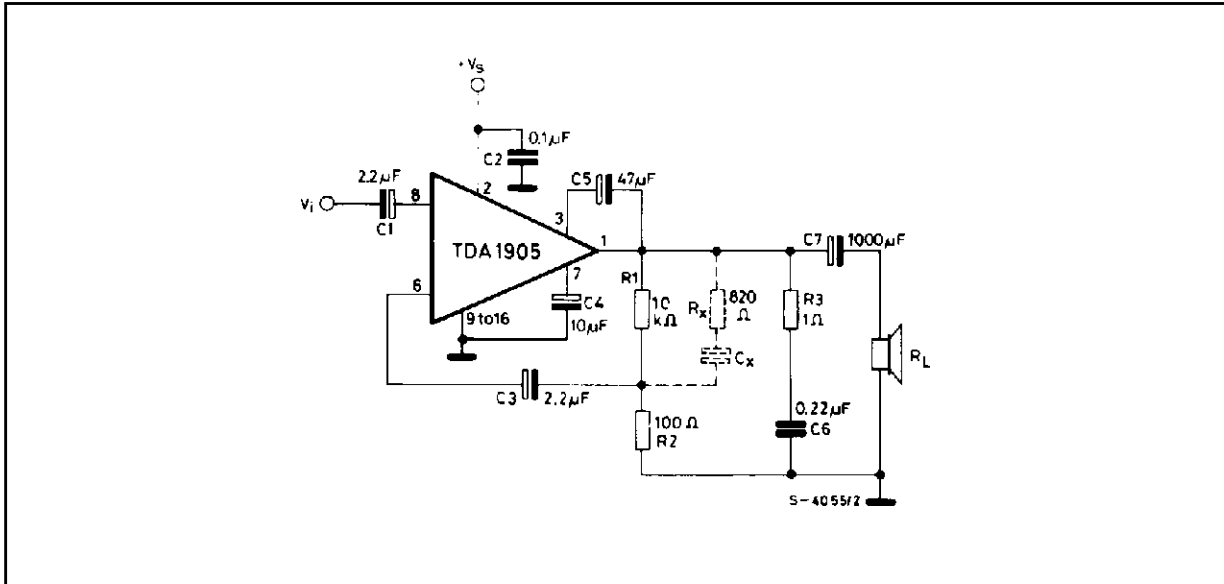
SCHEMATIC DIAGRAM



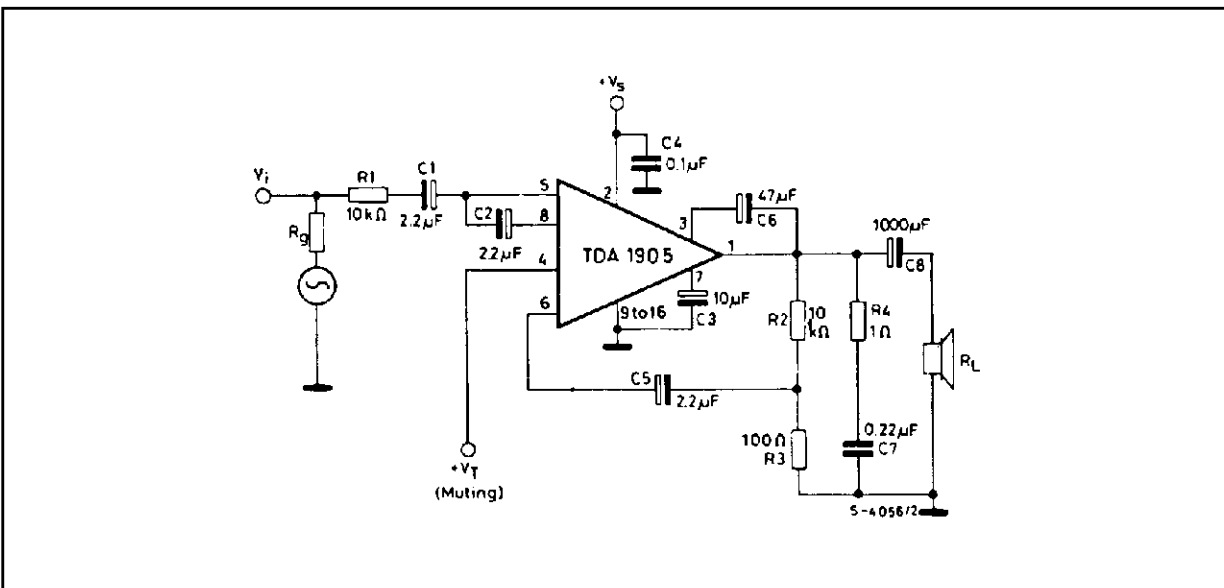
THERMAL DATA

| Symbol | Parameter | Value | Unit |
|------------------------|-------------------------------------|--------|------|
| R _{th-j-case} | Thermal resistance junction-pins | max 15 | °C/W |
| R _{th-j-amb} | Thermal resistance junction-ambient | max 70 | °C/W |

TEST CIRCUITS:
WITHOUT MUTING



WITH MUTING FUNCTION



ELECTRICAL CHARACTERISTICS (Refer to the test circuit, $T_{amb} = 25\text{ }^{\circ}\text{C}$, R_{th} (heatsink) = $20\text{ }^{\circ}\text{C/W}$, unless otherwise specified)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------------|---------------------------------|---|--------------------------|--------------------------|--------------------|------------------|
| V_s | Supply voltage | | 4 | | 30 | V |
| V_o | Quiescent output voltage | $V_s = 4\text{V}$ $V_s = 14\text{V}$ $V_s = 30\text{V}$ | 1.6 6.7 14.4 | 2.1 7.2 15.5 | 2.5 7.8 16.8 | V |
| I_d | Quiescent drain current | $V_s = 4\text{V}$ $V_s = 14\text{V}$ $V_s = 30\text{V}$ | | 15 17 21 | 35 | mA |
| $V_{CE\text{ sat}}$ | Output stage saturation voltage | $I_C = 1\text{A}$ $I_C = 2\text{A}$ | | 0.5 1 | | V |
| P_o | Output power | $d = 10\%$ $f = 1\text{KHz}$ $V_s = 9\text{V}$ $R_L = 4\Omega$ (*) $V_s = 14\text{V}$ $R_L = 4\Omega$ $V_s = 18\text{V}$ $R_L = 8\Omega$ $V_s = 24\text{V}$ $R_L = 16\Omega$ | 2.2 5 5 4.5 | 2.5 5.5 5.5 5.3 | | W |
| d | Harmonic distortion | $f = 1\text{KHz}$ $V_s = 9\text{V}$ $R_L = 4\Omega$ $P_o = 50\text{ mW to } 1.5\text{W}$ $V_s = 14\text{V}$ $R_L = 4\Omega$ $P_o = 50\text{ mW to } 3\text{W}$ $V_s = 18\text{V}$ $R_L = 8\Omega$ $P_o = 50\text{ mW to } 3\text{W}$ $V_s = 24\text{V}$ $R_L = 16\Omega$ $P_o = 50\text{ mW to } 3\text{W}$ | | 0.1 0.1 0.1 0.1 | | % |
| V_i | Input sensitivity | $f = 1\text{KHz}$ $V_s = 9\text{V}$ $R_L = 4\Omega$ $P_o = 2.5\text{W}$ $V_s = 14\text{V}$ $R_L = 4\Omega$ $P_o = 5.5\text{W}$ $V_s = 18\text{V}$ $R_L = 8\Omega$ $P_o = 5.5\text{W}$ $V_s = 24\text{V}$ $R_L = 16\Omega$ $P_o = 5.3\text{W}$ | | 37 49 73 100 | | mV |
| V_i | Input saturation voltage (rms) | $V_s = 9\text{V}$ $V_s = 14\text{V}$ $V_s = 18\text{V}$ $V_s = 24\text{V}$ | 0.8 1.3 1.8 2.4 | | | V |
| R_i | Input resistance (pin 8) | $f = 1\text{KHz}$ | 60 | 100 | | $\text{K}\Omega$ |
| I_d | Drain current | $f = 1\text{KHz}$ $V_s = 9\text{V}$ $R_L = 4\Omega$ $P_o = 2.5\text{W}$ $V_s = 14\text{V}$ $R_L = 4\Omega$ $P_o = 5.5\text{W}$ $V_s = 18\text{V}$ $R_L = 8\Omega$ $P_o = 5.5\text{W}$ $V_s = 24\text{V}$ $R_L = 16\Omega$ $P_o = 5.3\text{W}$ | | 380 550 410 295 | | mA |
| η | Efficiency | $f = 1\text{KHz}$ $V_s = 9\text{V}$ $R_L = 4\Omega$ $P_o = 2.5\text{W}$ $V_s = 14\text{V}$ $R_L = 4\Omega$ $P_o = 5.5\text{W}$ $V_s = 18\text{V}$ $R_L = 8\Omega$ $P_o = 5.5\text{W}$ $V_s = 24\text{V}$ $R_L = 16\Omega$ $P_o = 5.3\text{W}$ | | 73 71 74 75 | | % |

(*) With an external resistor of 100Ω between pin 3 and $+V_s$.

ELECTRICAL CHARACTERISTICS (continued)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------|--|---|--|-------------------|------|------------|
| BW | Small signal bandwidth (-3dB) | $V_s = 14V$ $R_L = 4\Omega$ $P_o = 1W$ | 40 to 40,000 | | | Hz |
| G_v | Voltage gain (open loop) | $V_s = 14V$ $f = 1KHz$ | | 75 | | dB |
| G_v | Voltage gain (closed loop) | $V_s = 14V$ $R_L = 4\Omega$ $f = 1KHz$ $P_o = 1W$ | 39.5 | 40 | 40.5 | dB |
| e_N | Total input noise | $R_g = 50\Omega$ $R_g = 1K\Omega$ $(^\circ)$ $R_g = 10K\Omega$ | | 1.2 1.3 1.5 | 4.0 | μV |
| | | $R_g = 50\Omega$ $R_g = 1K\Omega$ $(^\circ\circ)$ $R_g = 10K\Omega$ | | 2.0 2.0 2.2 | 6.0 | μV |
| S/N | Signal to noise ratio | $V_s = 14V$ $P_o = 5.5W$ $R_L = 4\Omega$ | $R_g = 10K\Omega$ $R_g = 0$ $(^\circ)$ | 90 92 | | dB |
| | | | $R_g = 10K\Omega$ $R_g = 0$ $(^\circ\circ)$ | 87 87 | | dB |
| SVR | Supply voltage rejection | $V_s = 18V$ $R_L = 8\Omega$ $f_{ripple} = 100 Hz$ $R_g = 10K\Omega$ $V_{ripple} = 0.5V_{rms}$ | 40 | 50 | | dB |
| T_{sd} | Thermal shut-down case temperatura (*) | $P_{tot} = 2.5W$ | | 115 | | $^\circ C$ |

MUTING FUNCTION

| | | | | | | |
|---------------|--------------------------------------|-------------------------|-----|-----|-------|-----------|
| $V_{T_{OFF}}$ | Muting-off threshold voltage (pin 4) | | 1.9 | | 4.7 | V |
| $V_{T_{ON}}$ | Muting-on threshold voltage (pin 4) | | 0 | | 1.3 | V |
| | | | 6.2 | | V_s | |
| R_5 | Input-resistance (pin 5) | Muting off | 80 | 200 | | $K\Omega$ |
| | | Muting on | | 10 | 30 | Ω |
| R_4 | Input resistance (pin 4) | | 150 | | | $K\Omega$ |
| A_T | Muting attenuation | $R_g + R_1 = 10K\Omega$ | 50 | 60 | | dB |

Note:

- ($^\circ$) Weighting filter = curve A.
($^\circ\circ$) Filter with noise bandwidth: 22 Hz to 22 KHz.
(*) See fig. 30 and fig. 31

Figure 1. Quiescent output voltage vs. supply voltage

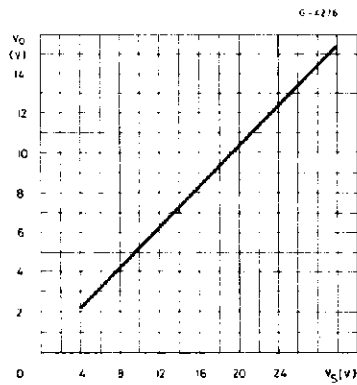


Figure 2. Quiescent drain current vs. supply voltage

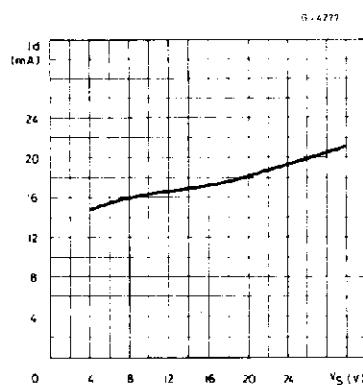


Figure 3. Output power vs. supply voltage

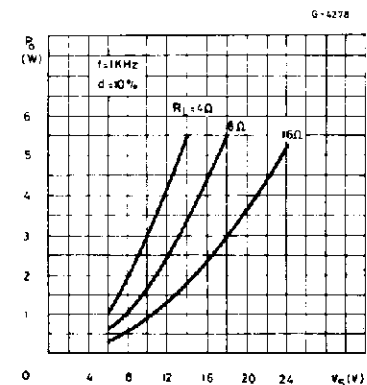


Figure 4. Distortion vs. output power ($R_L = 16\Omega$)

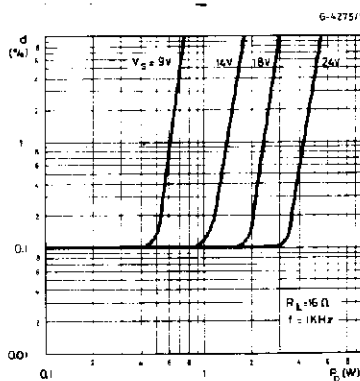


Figure 5. Distortion vs. output power ($R_L = 8\Omega$)

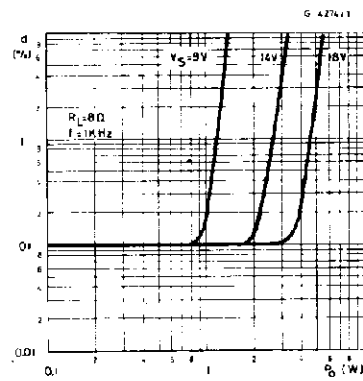


Figure 6. Distortion vs. output power ($R_L = 4\Omega$)

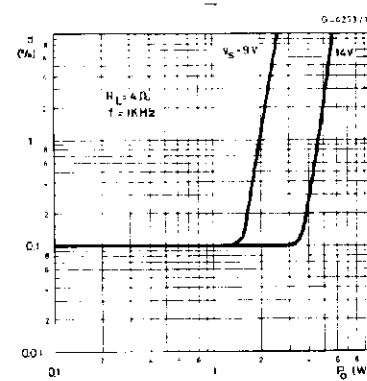


Figure 7. Distortion vs. frequency ($R_L = 16\Omega$)

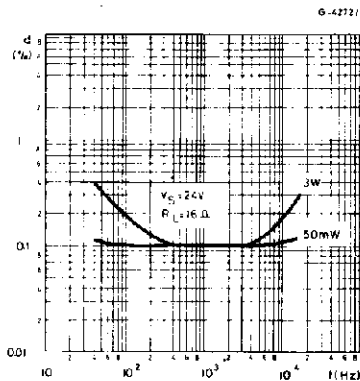


Figure 8. Distortion vs. frequency ($R_L = 8\Omega$)

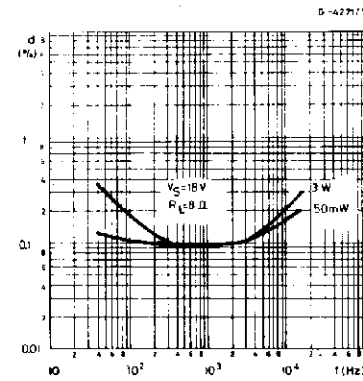


Figure 9. Distortion vs. frequency ($R_L = 4\Omega$)

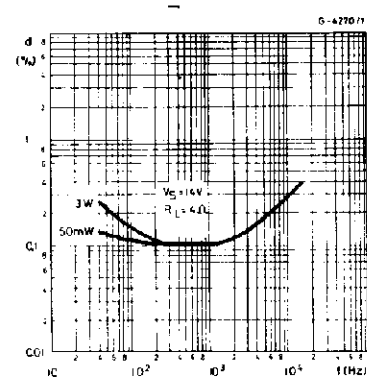


Figure 10. Open loop frequency response

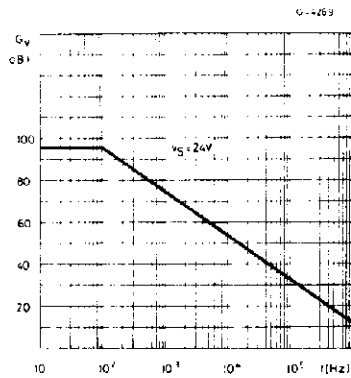


Figure 11. Output power vs. input voltage

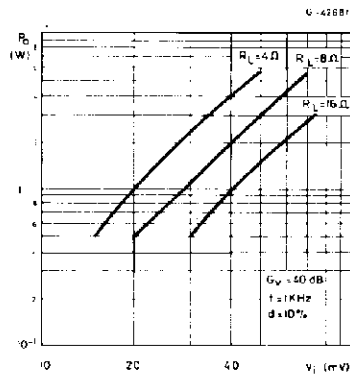


Figure 12. Value of capacitor Cx vs. bandwidth (BW) and gain (Gv)

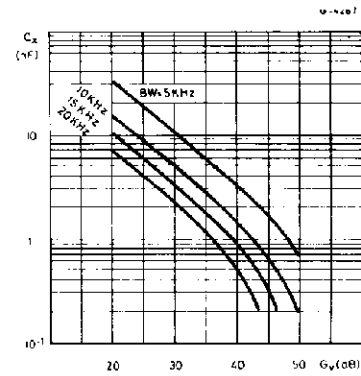


Figure 13. Supply voltage rejection vs. voltage gain (ref. to the Muting circuit)

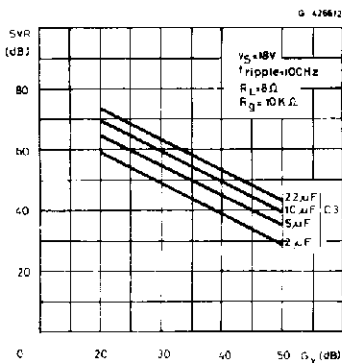


Figure 14. Supply voltage rejection vs. source resistance

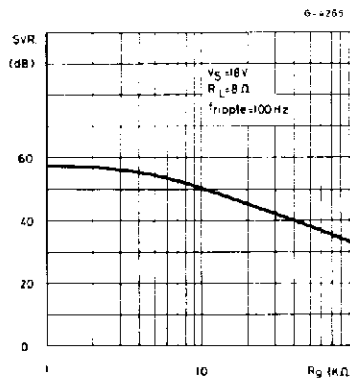


Figure 15. Max power dissipation vs. supply voltage (sine wave operation)

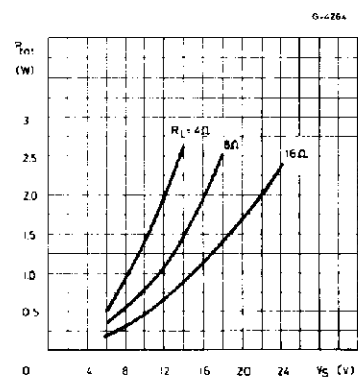


Figure 16. Power dissipation and efficiency vs. output power

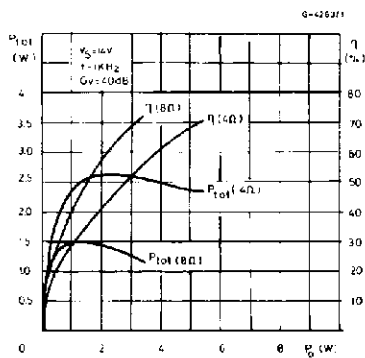


Figure 17. Power dissipation and efficiency vs. output power

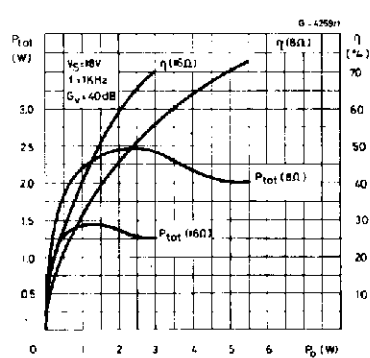
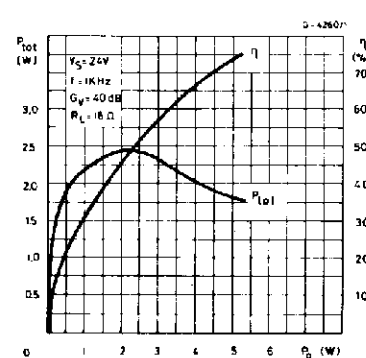


Figure 18. Power dissipation and efficiency vs. output power



APPLICATION INFORMATION

Figure 19. Application circuit without muting

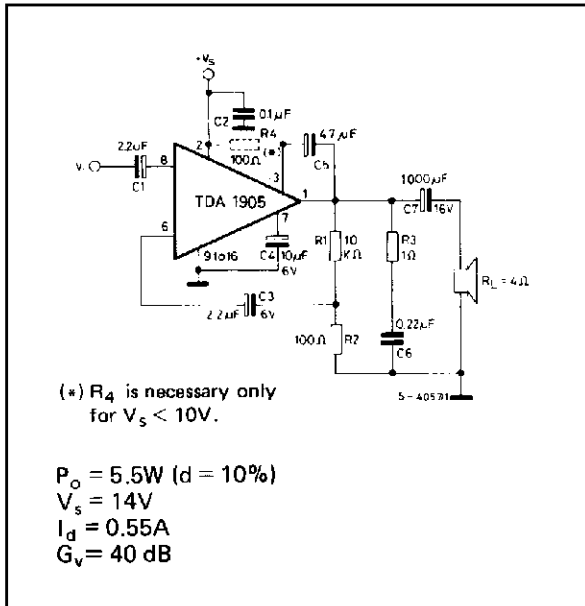


Figure 20. PC board and components lay-out of the circuit of fig. 19 (1 : 1 scale)

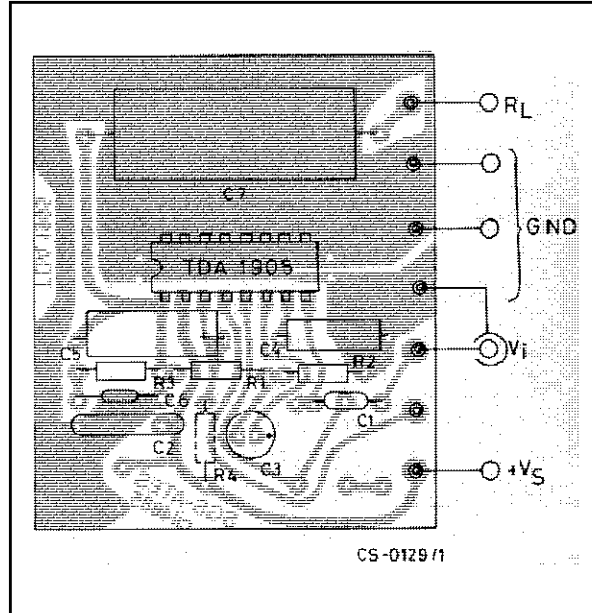


Figure 21. Application circuit with muting

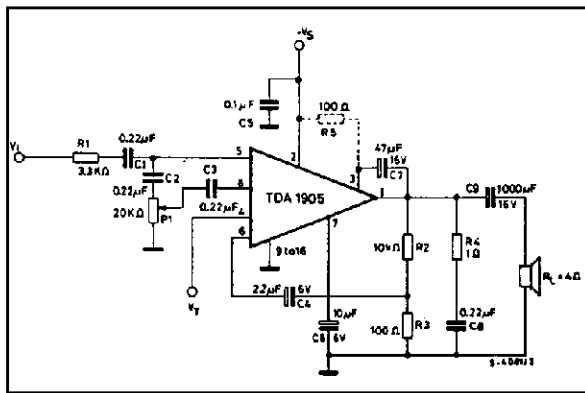
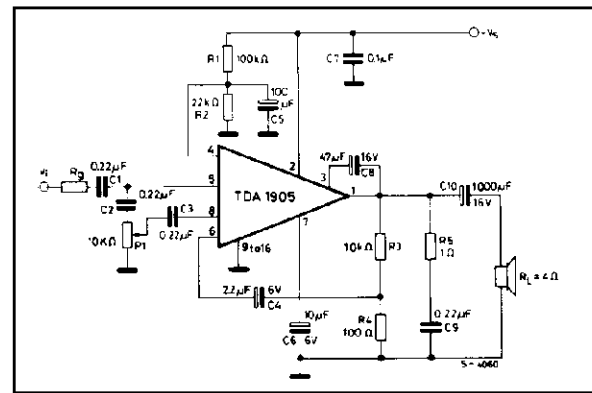


Figure 22. Delayed muting circuit



APPLICATION INFORMATION (continued)

Figure 23. Low-cost application circuit without bootstrap.

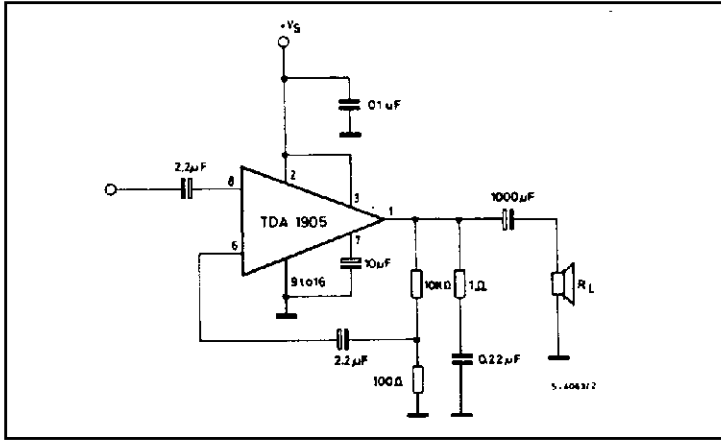


Figure 24. Output power vs. supply voltage (circuit of fig. 23)

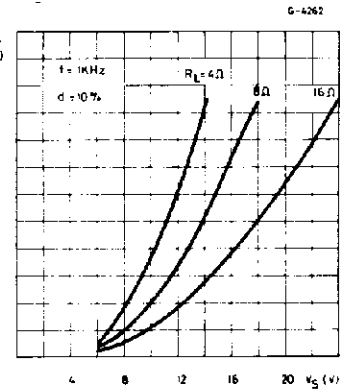


Figure 25. Two position DC tone control using change of pin 5 resistance (muting function)

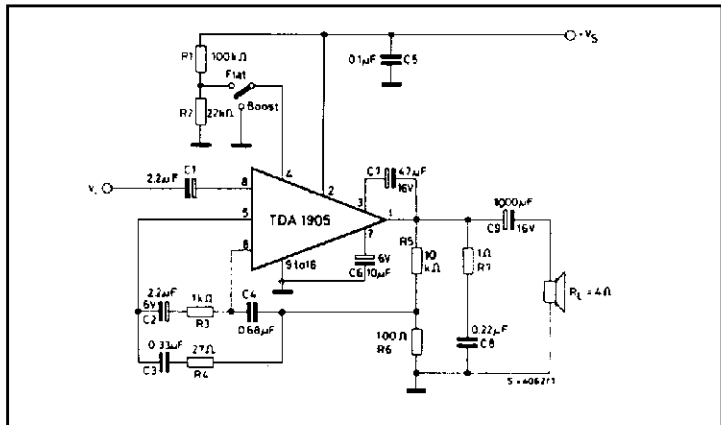


Figure 26. Frequency response of the circuit of fig. 25

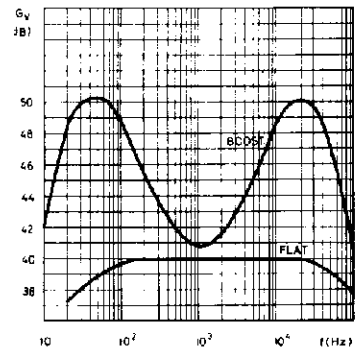


Figure 27. Bass Bomb tone control using change of pin 5 resistance (muting function)

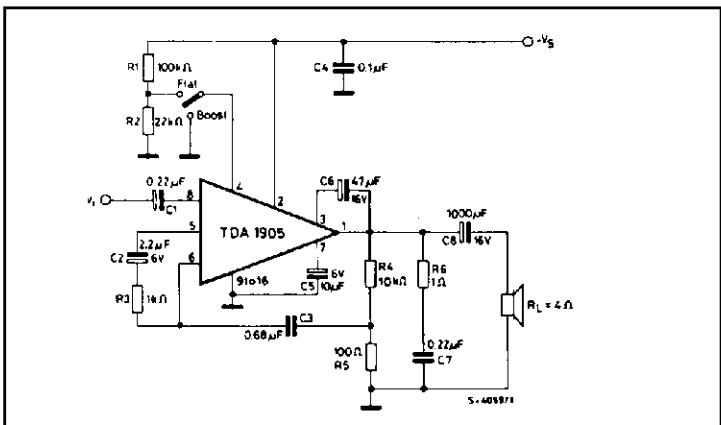
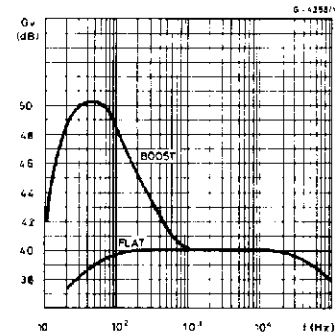


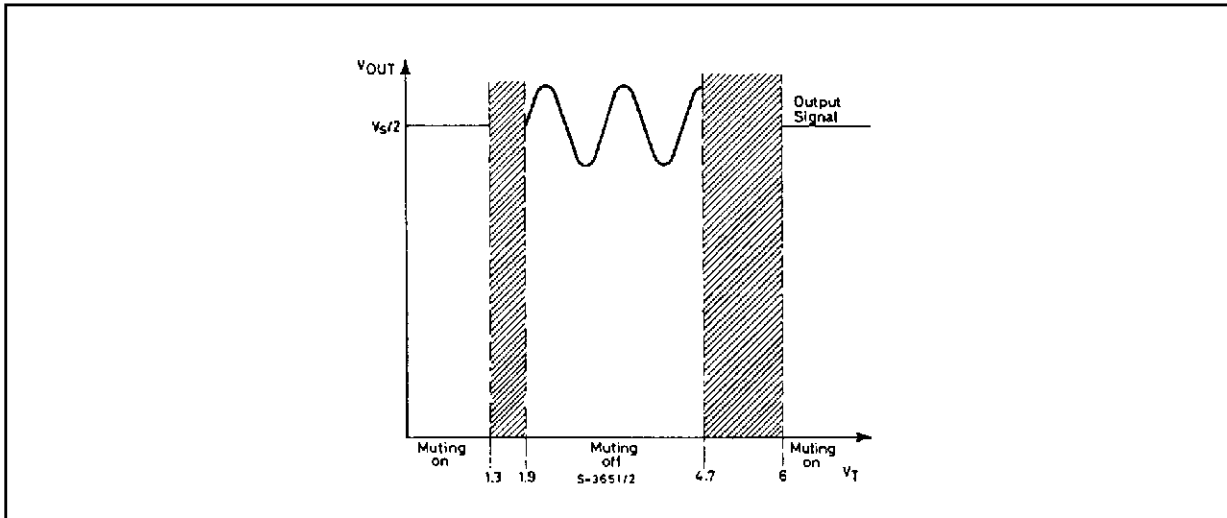
Figure 28. Frequency response of the circuit of fig. 27



MUTING FUNCTION

The output signal can be inhibited applying a DC voltage V_T to pin 4, as shown in fig. 29

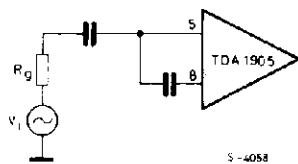
Figure 29



The input resistance at pin 5 depends on the threshold voltage V_T at pin 4 and is typically :

| | | | |
|----------------------------|---|--|------------|
| $R_5 = 200\text{ K}\Omega$ | @ | $1.9\text{V} \leq V_T \leq 4.7\text{V}$ | muting-off |
| $R_5 = 10\ \Omega$ | @ | $0\text{V} \leq V_T \leq 1.3\text{V}$ $6\text{V} \leq V_T \leq V_s$ | muting-on |

Referring to the following input stage, the possible attenuation of the input signal and therefore of the output signal can be found using the following expression:



$$A_T = \frac{V_i}{V_8} = \frac{R_g + \left(\frac{R_8 \cdot R_5}{R_8 + 5} \right)}{\left(\frac{R_8 \cdot R_5}{R_8 + R_5} \right)}$$

where $R_8 \cong 100\text{ K}\Omega$

Considering $R_g = 10\text{ K}\Omega$ the attenuation in the muting-on condition is typically $A_T = 60\text{ dB}$. In the muting-off condition, the attenuation is very low, typically 1.2 dB.

A very low current is necessary to drive the threshold voltage V_T because the input resistance at pin 4 is greater than 150 K Ω . The muting function can be used in many cases, when a temporary inhibition of the output signal is requested, for example:

- in switch-on condition, to avoid preamplifier power-on transients (see fig. 22)

- during switching at the input stages.
- during the receiver tuning.

The variable impedance capability at pin 5 can be useful in many applications and two examples are shown in fig. 25 and 27, where it has been used to change the feedback network, obtaining 2 different frequency responses.

APPLICATION SUGGESTION

The recommended values of the external components are those shown on the application circuit of fig. 21. When the supply voltage V_s is less than 10V, a 100 Ω resistor must be connected between pin 2 and pin 3 in order to obtain the maximum output power.

Different values can be used. The following table can help the designer.

| Component | Raccom. value | Purpose | Larger than recommended value | Smaller than recommended value | Allowed range | |
|-------------------------|---------------|---|--|---|---------------|---------------|
| | | | | | Min. | Max. |
| $R_g + R_1$ | 10K Ω | Input signal impeded for muting operation | Increase of the attenuation in muting-on condition. Decrease of the input sensitivity. | Decrease of the attenuation in muting on condition. | | |
| R_2 | 10K Ω | Feedback resistors | Increase of gain. | Decrease of gain. Increase quiescent current. | 9 R_3 | |
| R_3 | 100 Ω | | Decrease of gain. | Increase of gain. | | 1K Ω |
| R_4 | 1K Ω | Frequency stability | Danger of oscillation at high frequencies with inductive loads. | | | |
| R_5 | 100 Ω | Increase of the output swing with low supply voltage. | | | 47 | 330 |
| P_1 | 20K Ω | Volume potentiometer | Increase of the switch-on noise. | Decrease of the input impedance and of the input level. | 10K Ω | 100K Ω |
| C_1 C_2 C_3 | 0.22 μ F | Input DC decoupling. | Higher cost lower noise. | Higher low frequency cutoff. Higher noise. | | |
| C_4 | 2.2 μ F | Inverting input DC decoupling. | Increase of the switch-on noise. | Higher low frequency cutoff. | 0.1 μ F | |
| C_5 | 0.1 μ F | Supply voltage bypass. | | Danger of oscillations. | | |
| C_6 | 10 μ F | Ripple rejection | Increase of SVR increase of the switch-on time | Degradation of SVR | 2.2 μ F | 100 μ F |
| C_7 | 47 μ F | Bootstrap. | | Increase of the distortion at low frequency. | 10 μ F | 100 μ F |
| C_8 | 0.22 μ F | Frequency stability. | | Danger of oscillation. | | |
| C_9 | 1000 μ F | Output DC decoupling. | | Higher low frequency cutoff. | | |

THERMAL SHUT-DOWN

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

- 1) An overload on the output (even if it is permanent), or an above limit ambient temperature can be easily tolerated since the T_j cannot be higher than 150°C .
- 2) The heatsink can have a smaller factor of safety compared with that of a conventional circuit. There is no possibility of device damage due to high junction temperature.
If for any reason, the junction temperature increases up to 150°C , the thermal shut-down simply reduces the power dissipation and the current consumption.

The maximum allowable power dissipation depends upon the size of the external heatsink (i.e. its thermal resistance); fig. 32 shows this dissipable power as a function of ambient temperature for different thermal resistance.

Figure 30. Output power and drain current vs. case temperature

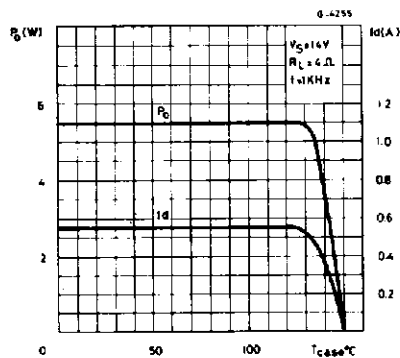


Figure 31. Output power and drain current vs. case temperature

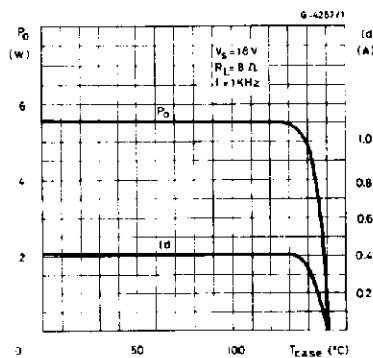
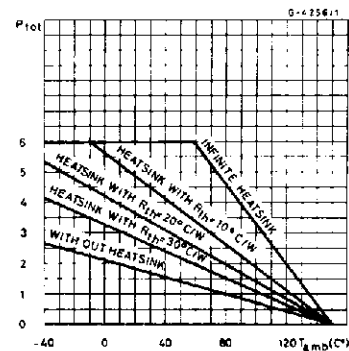


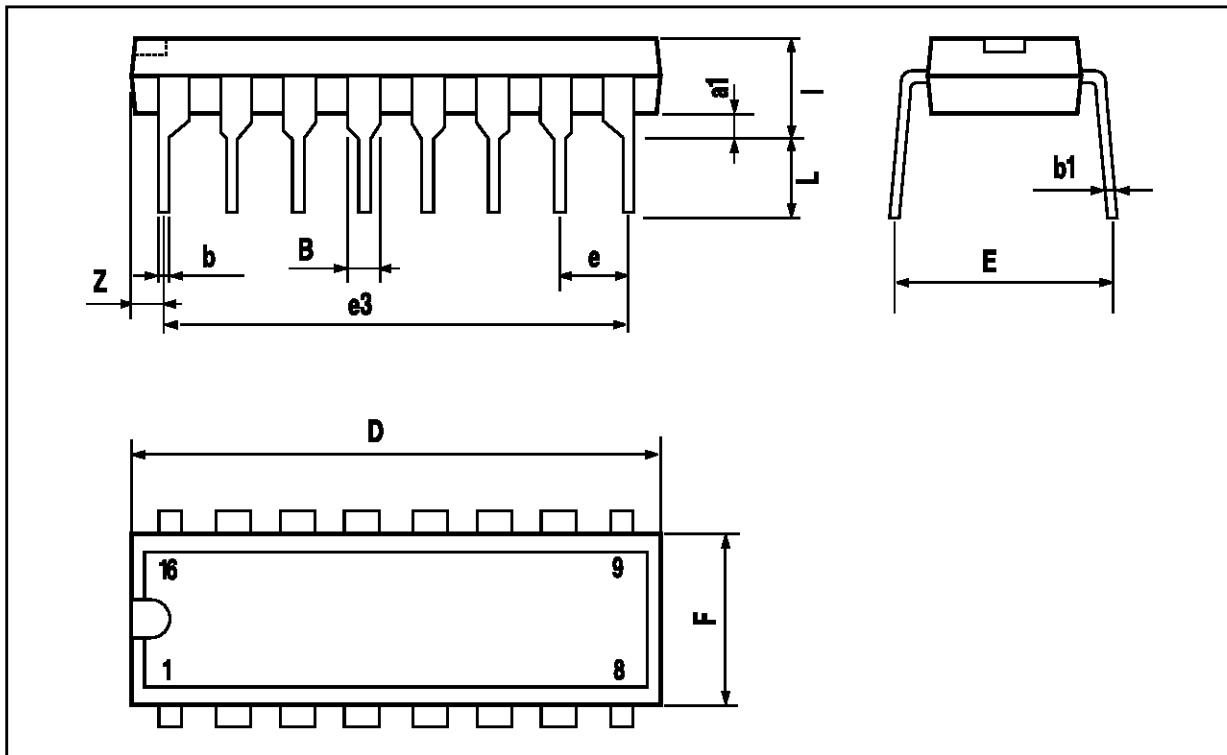
Figure 32. Maximum allowable power dissipation vs. ambient temperature



MOUNTING INSTRUCTION : See TDA1904

POWERDIP PACKAGE MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.85 | | 1.40 | 0.033 | | 0.055 |
| b | | 0.50 | | | 0.020 | |
| b1 | 0.38 | | 0.50 | 0.015 | | 0.020 |
| D | | | 20.0 | | | 0.787 |
| E | | 8.80 | | | 0.346 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 17.78 | | | 0.700 | |
| F | | | 7.10 | | | 0.280 |
| I | | | 5.10 | | | 0.201 |
| L | | 3.30 | | | 0.130 | |
| Z | | | 1.27 | | | 0.050 |



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