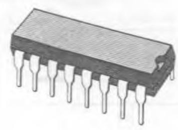
5 W AUDIO AMPLIFIER WITH MUTING

- MUTING FACILITY
- PROTECTION AGAINST CHIP OVER TEMPERATURE
- VERY LOW NOISE
- HIGH SUPPLY VOLTAGE REJECTION
- LOW "SWITCH-ON" NOISE
- VOLTAGE RANGE 4 V TO 30 V



Powerdip
(8 + 8)

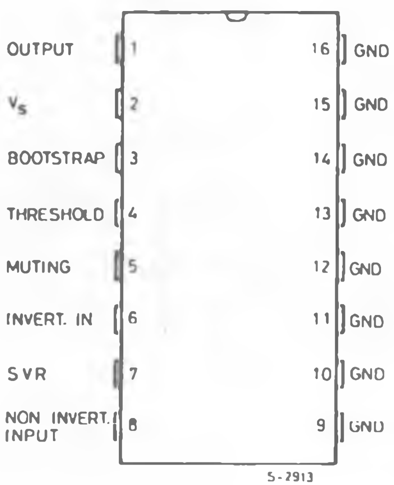
ORDER CODE : TDA1905

DESCRIPTION

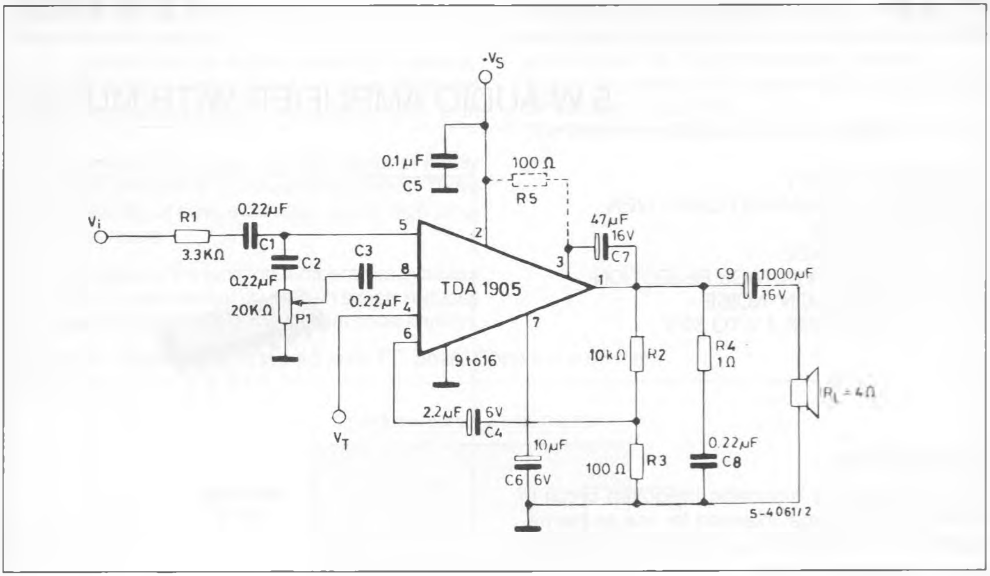
The TDA1905 is a monolithic integrated circuit in POWERDIP package, intended for use as low frequency power amplifier in a wide range of applications in radio and TV sets.

The TDA1905 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 6 W and a thermal resistance of 15 °C/W (junction to pins).

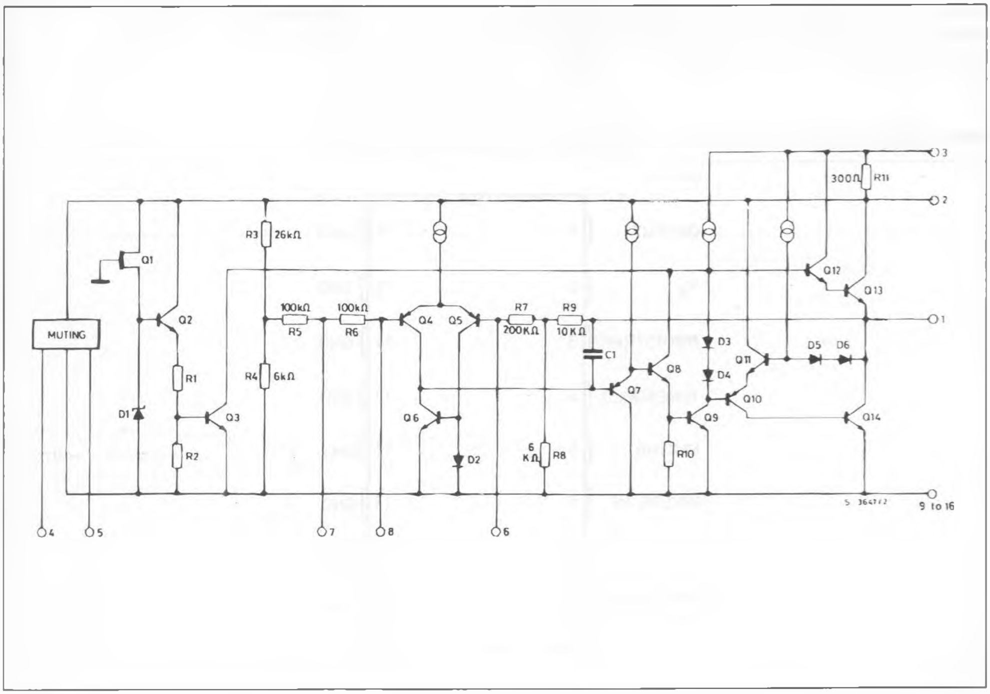
PIN CONNECTION (top view)



APPLICATION CIRCUIT



SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

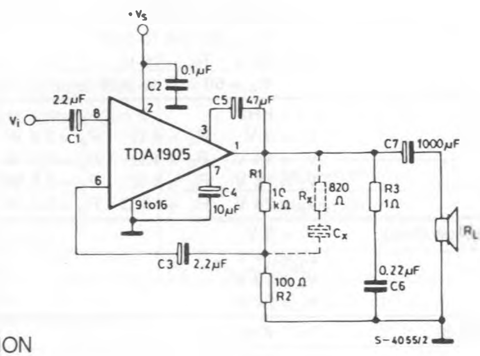
Symbol	Parameter	Value	Unit
V_s	Supply Voltage	30	V
I_o	Output Peak Current (non repetitive)	3	A
I_o	Output Peak Current (repetitive)	2.5	A
V_i	Input Voltage	0 to + V_s	V
V_i	Differential Input Voltage	± 7	V
V_{11}	Muting Threshold Voltage	V_s	V
P_{tot}	Power Dissipation at T_{amb} = 80 °C T_{case} = 60 °C	1 6	W W
T_{stg}, T_j	Storage and Junction Temperature	– 40 to 150	°C

THERMAL DATA

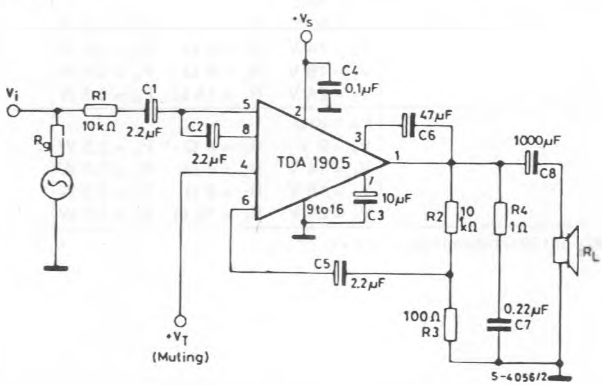
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-pins	Max.	15	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-amb	Max.	70	°C/W

TEST CIRCUITS

WITHOUT MUTING



WITH MUTING FUNCTION



ELECTRICAL CHARACTERISTICS (refer to the test circuit, T_{amb} = 25 °C, R_{th} (heatsink) = 20 °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 V V_s = 14 V V_s = 30 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 V V_s = 14 V V_s = 30 V		15 17 21	 35	mA
$V_{CE\ sat}$	Output Stage Saturation Voltage	I_C = 1 A I_C = 2 A		0.5 1		V
P_o	Output Power	d = 10 % f = 1 KHz V_s = 9 V R_L = 4 Ω (*) V_s = 14 V R_L = 4 Ω V_s = 18 V R_L = 8 Ω V_s = 24 V R_L = 16 Ω	 2.2 5 5 4.5	 2.5 5.5 5.5 5.3		W
d	Harmonic Distortion	f = 1 KHz V_s = 9 V R_L = 4 Ω P_o = 50 mW to 1.5 W V_s = 14 V R_L = 4 Ω P_o = 50 mW to 3 W V_s = 18 V R_L = 8 Ω P_o = 50 mW to 3 W V_s = 24 V R_L = 16 Ω P_o = 50 mW to 3 W		 0.1 0.1 0.1 0.1		%
V_i	Input Sensitivity	f = 1 KHz V_s = 9 V R_L = 4 Ω P_o = 2.5 W V_s = 14 V R_L = 4 Ω P_o = 5.5 W V_s = 18 V R_L = 8 Ω P_o = 5.5 W V_s = 24 V R_L = 16 Ω P_o = 5.3 W		 37 49 73 100		mV
V_i	Input Saturation Voltage (rms)	V_s = 9 V V_s = 14 V V_s = 18 V V_s = 24 V	0.8 1.3 1.8 2.4			V
R_i	Input Resistance (pin 8)	f = 1 KHz	60	100		KΩ
I_d	Drain Current	f = 1 KHz V_s = 9 V R_L = 4 Ω P_o = 2.5 W V_s = 14 V R_L = 4 Ω P_o = 5.5 W V_s = 18 V R_L = 8 Ω P_o = 5.5 W V_s = 24 V R_L = 16 Ω P_o = 5.3 W		 380 550 410 295		mA
η	Efficiency	f = 1 KHz V_s = 9 V R_L = 4 Ω P_o = 2.5 W V_s = 14 V R_L = 4 Ω P_o = 5.5 W V_s = 18 V R_L = 8 Ω P_o = 5.5 W V_s = 24 V R_L = 16 Ω P_o = 5.3 W		 73 71 74 75		%

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

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
BW	Small Signal bandwidth (– 3 dB)	V_s = 14 V R_L = 4 Ω P_o = 1 W	40 to 40,000			Hz
G_v	Voltage Gain (open loop)	Vs = 14 V f = 1 KHz		75		dB
G_v	Voltage Gain (closed loop)	V_s = 14 V R_L = 4 Ω f = 1 KHz P_o = 1 W	39.5	40	40.5	dB
e_N	Total Input Noise	R_g = 50 Ω R_g = 1 kΩ (°) R_g = 10 kΩ		1.2 1.3 1.5	 4.0	µV
		R_g = 50 Ω R_g = 1 kΩ (°°) R_g = 10 kΩ		2.0 2.0 2.2	 6.0	µV
S/N	Signal to Noise Ratio	V_s = 14 V P_o = 5.5 W R_L = 4 Ω R_g = 10 kΩ (°) R_g = 0		90 92		dB
		R_g = 10 kΩ (°°) R_g = 0		87 87		dB
SVR	Supply Voltage Rejection	V_s = 18 V R_L = 8 Ω f_{ripple} = 100 Hz R_g = 10 kΩ V_{ripple} = 0.5 V_{rms}	40	50		dB
T_{sd}	Thermal Shut-down Case Temperature (*)	P_{tot} = 2.5 W		115		°C

MUTING FUNCTION

V_{TOFF}	Muting-off Threshold Voltage (pin 4)		1.9		4.7	V
V_{TON}	Muting-on Threshold Voltage (pin 4)		0		1.3	V
			6.2		V_s	V
R_5	Input Resistance (pin 5)	Muting-off	80	200		kΩ
		Muting-on		10	30	Ω
R_4	Input Resistance (pin 4)		150			kΩ
A_T	Muting Attenuation	R_g + R_1 = 10 kΩ	50	60		dB

Notes : (°) Weighting filter = curve A.
(°°) Filter with noise bandwidth : 22 Hz to 22 KHz.
(*) See fig. 30 and fig. 31.

Figure 1 : Quiescent Output Voltage vs. Supply Voltage.

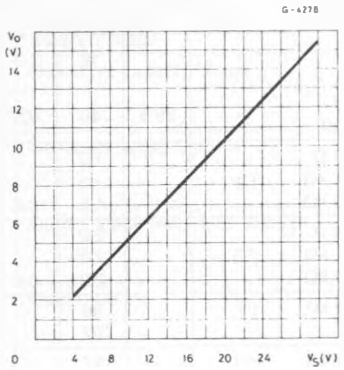


Figure 2 : Quiescent Drain Current vs. Supply Voltage.

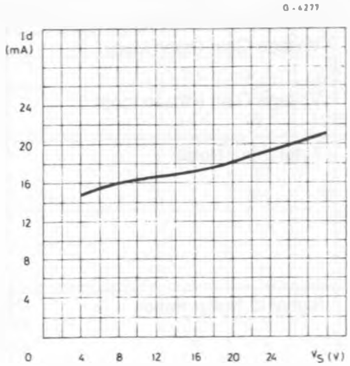


Figure 3 : Output Power vs. Supply Voltage.

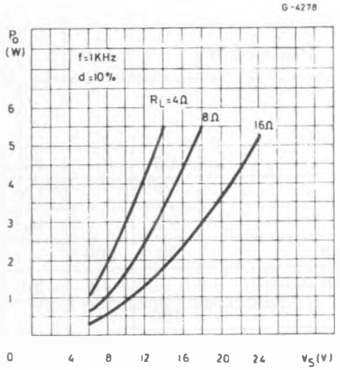


Figure 4 : Distortion vs. Output Power (RL = 16 Ω).

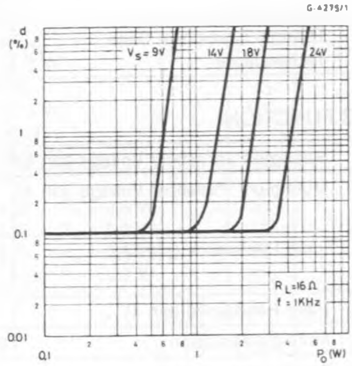


Figure 5 : Distortion vs. Output Power (RL = 8 Ω).

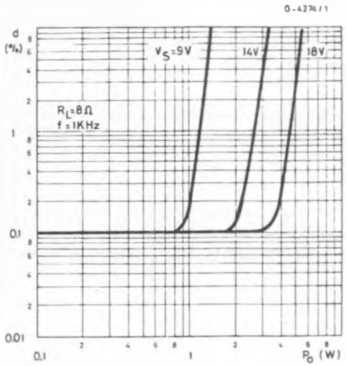


Figure 6 : Distortion vs. Output Power (RL = 4 Ω)

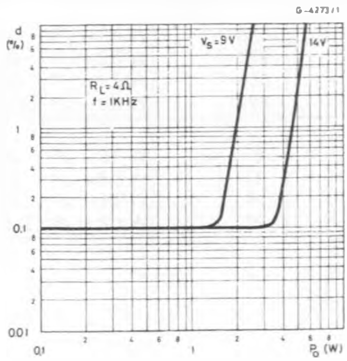


Figure 7 : Distortion vs. Frequency (R_L = 16 Ω).

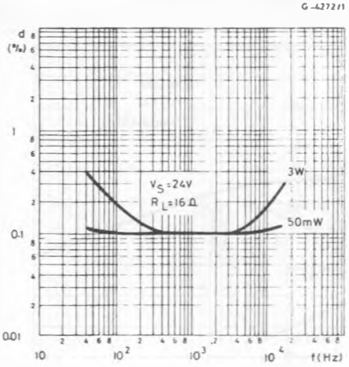


Figure 8 : Distortion vs. Frequency (R_L = 8 Ω).

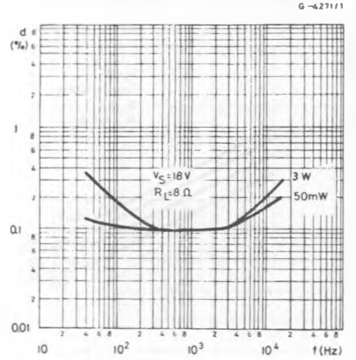


Figure 9 : Distortion vs. Frequency (R_L = 4 Ω).

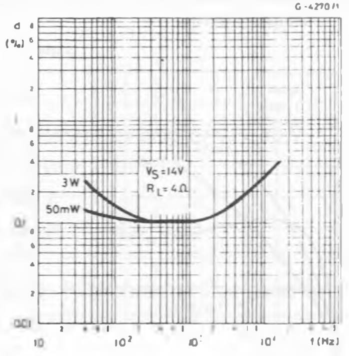


Figure 10 : Open Loop Frequency Response.

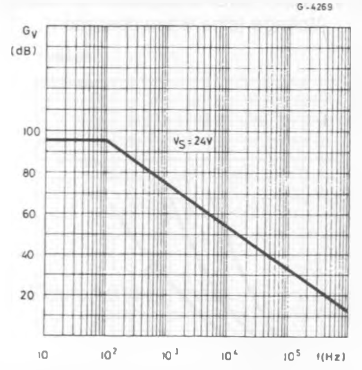


Figure 11 : Output Power vs. Input Voltage.

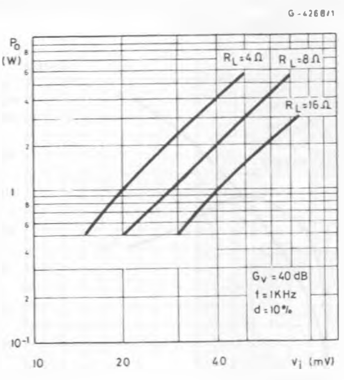


Figure 12 : Value of Capacitor Cx vs. Bandwidth (BW) and Gain (G_v).

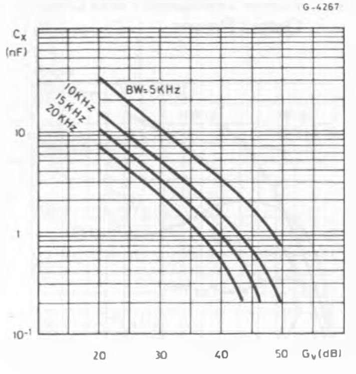


Figure 13 : Supply Voltage Rejection vs. Voltage Gain (ref. to the Muting circuit).

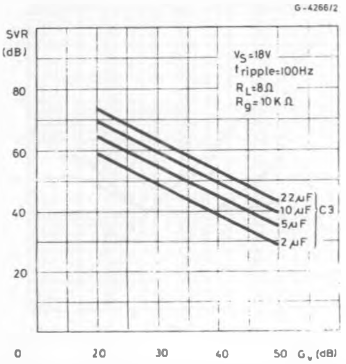


Figure 14 : Supply Voltage Rejection vs. Source Resistance.

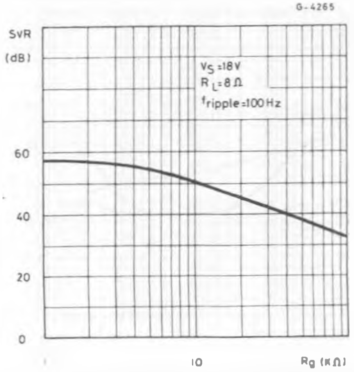


Figure 15 : Max Power Dissipation vs. Supply Voltage (sine wave operation).

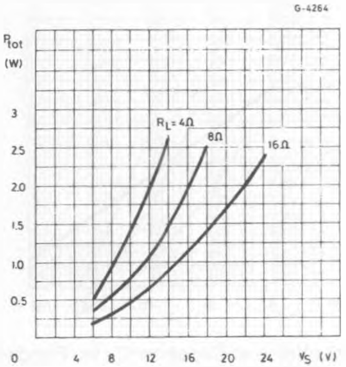


Figure 16 : Power Dissipation and Efficiency vs. Output Power.

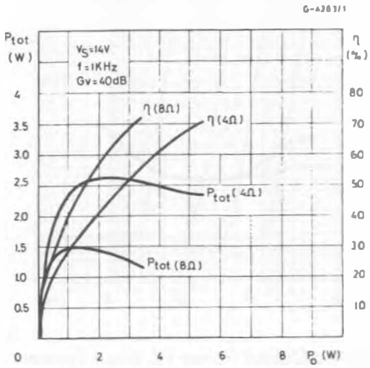


Figure 17 : Power Dissipation and Efficiency vs. Output Power.

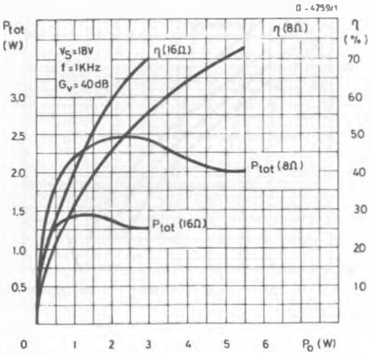
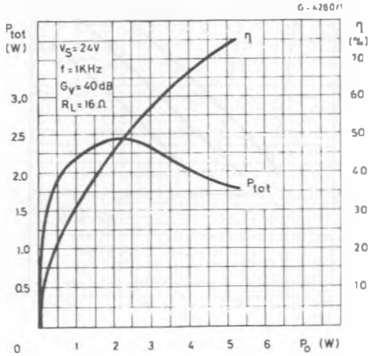
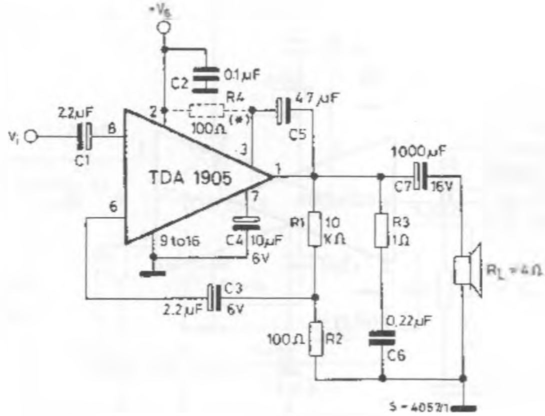


Figure 18 : Power Dissipation and Efficiency vs. Output Power.



APPLICATION INFORMATION

Figure 19 : Application Circuit without Muting.



(*) R_4 is necessary only for $V_s < 10$ V.

$P_o = 5.5$ W (d = 10 %)

$I_d = 0.55$ A

$G_v = 40$ dB

Figure 20 : PC Board and Components Layout of the Circuit of Figure 19 (1 : 1 scale).

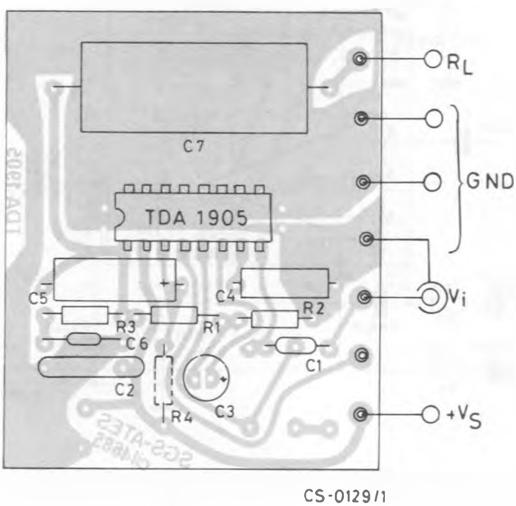


Figure 21 : Application Circuit with Muting.

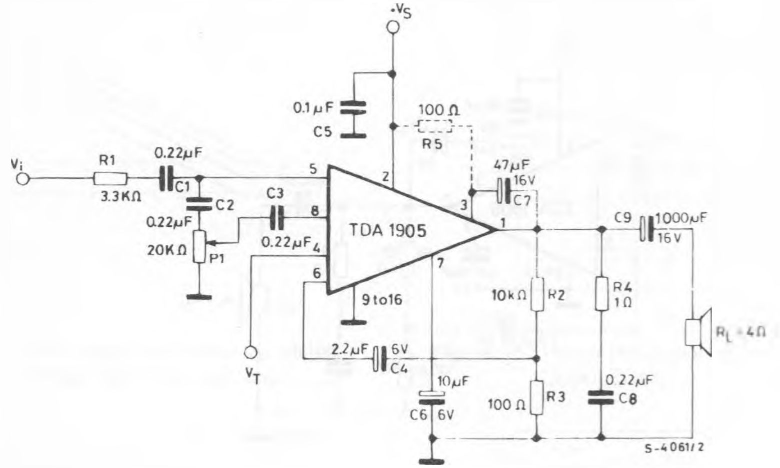


Figure 22 : Delayed Muting Circuit.

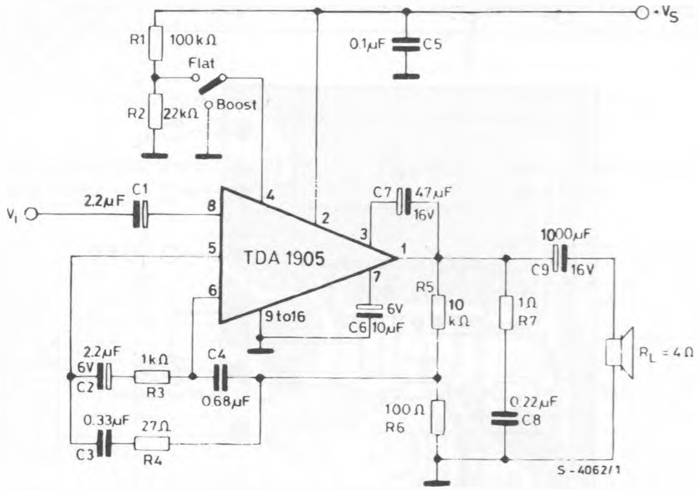


Figure 23 : Low-cost Application Circuit without Boostrap.

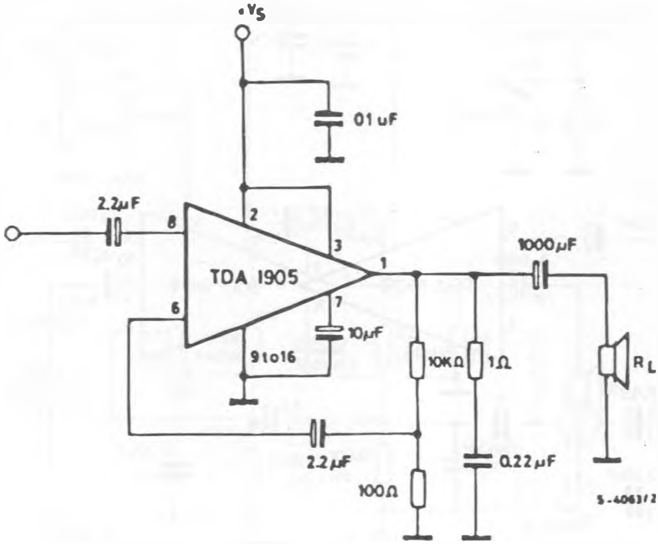


Figure 24 : Output Power vs. Supply Voltage (circuit of fig. 23).

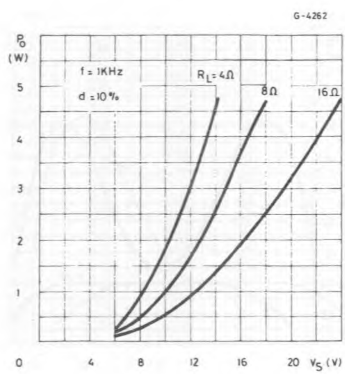


Figure 25 : Two Position DC Tone Control Using Change of Pin 5 Resistance (muting function).

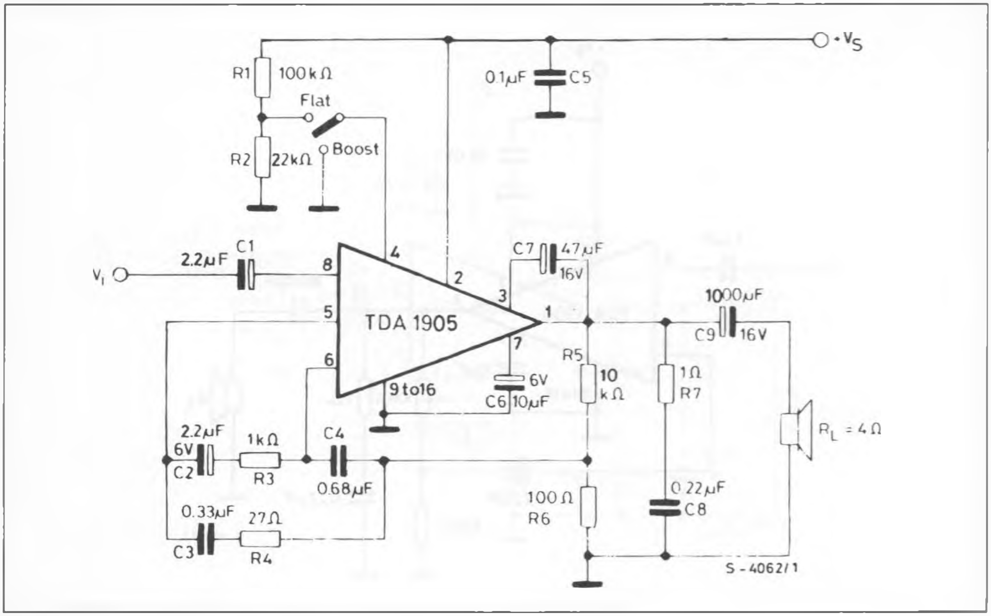


Figure 26 : Frequency Response of the Circuit of figure 25..

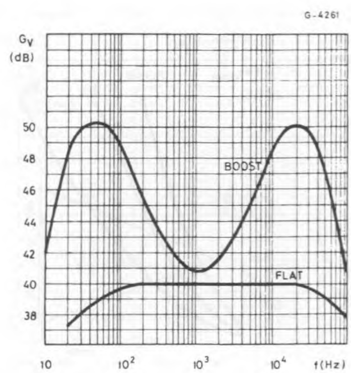


Figure 27 : Bass Bomb Tone Control Using Change of Pin 5 Resistance (muting function).

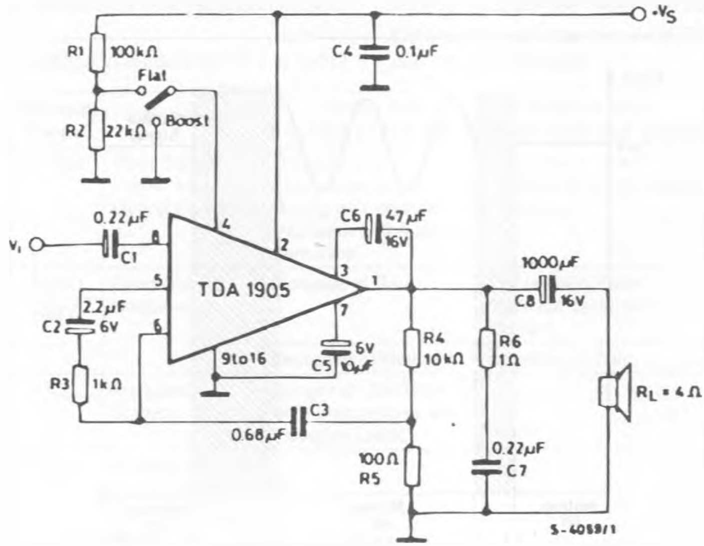
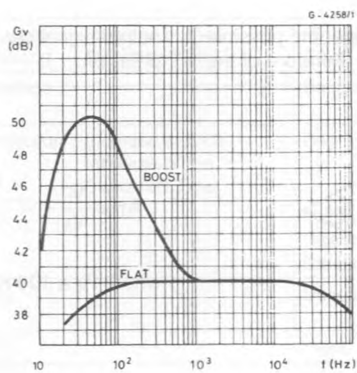


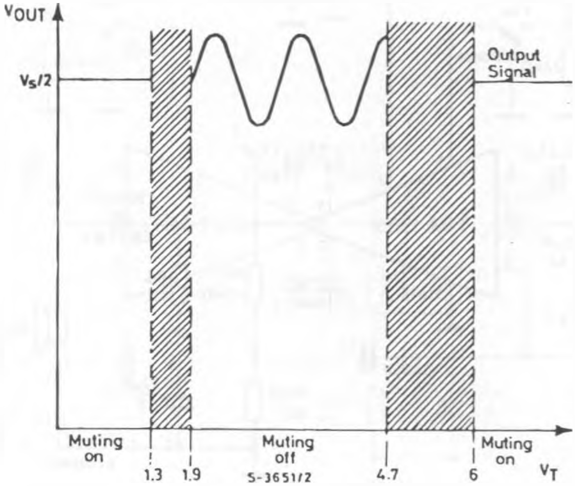
Figure 28 : Frequency Response of the Circuit of Figure 27.



MUTING FUNCTION

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

Figure 29 .

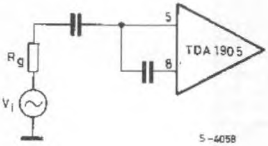


The input resistance at pin 5 depends on the threshold voltage V_T at pin 4 and is typically:

$R_5 = 200\ K\Omega$ @ $1.9\ V \leq V_T \leq 4.7\ V$ muting-off

$R_5 = 10\ \Omega$ @ $0V \leq V_T \leq 1.3\ V$, $6\ V \leq V_T \leq V_S$ 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 $R_8 \cong 100\ K\Omega$

Considering $R_g = 10\ K\Omega$ the attenuation in the muting-on condition is typically $A_T = 60$ 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 KΩ. 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 application and two examples are shown in fig.25 and 27, where it has been used to change the feedback network, obtaining 2 different frequency response.

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 10 V, 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.
$R_g + R_1$	10 KΩ	Input Signal Imped. 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	10 KΩ	Feedback Resistors	Increase of Gain	Decrease of Gain Increase Quiescent Current.	9 R_3	
R_3	100 Ω		Decrease of Gain	Increase of Gain		1 KΩ
R_4	1Ω	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	20 KΩ	Volume Potentiometer	Increase of the Switch-on Noise	Decrease of the Input Impedance and of the Input Level	10 KΩ	100 KΩ
C_1 C_2 C_3	0.22 µF	Input DC Decoupling.	Higher Cost Lower Noise.	Higher Low Frequency Cutoff. Higher Noise.		
C_4	2.2 µF	Inverting Input DC Decoupling.	Increase of the Switch-on Noise.	Higher Low Frequency Cutoff.	0.1 µF	
C_5	0.1 µF	Supply Voltage Bypass.		Danger of Oscillations.		
C_6	10 µF	Ripple Rejection	Increase of SVR Increase of the Switch-on Time	Degradation of SVR	2.2 µF	100 µF
C_7	47 µF	Bootstrap.		Increase of the Distortion at Low Frequency.	10 µF	100 µF
C_8	0.22 µF	Frequency Stability.		Danger of Oscillation.		
C_9	1000 µF	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.

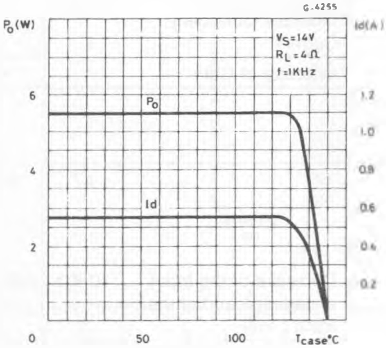


Figure 31 : Output Power and Drain Current vs. Case Temperature.

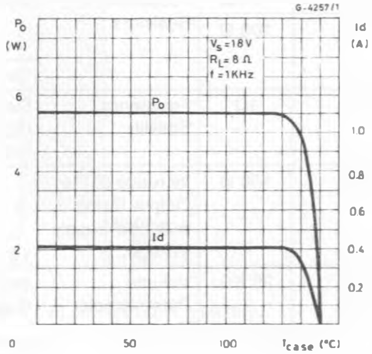
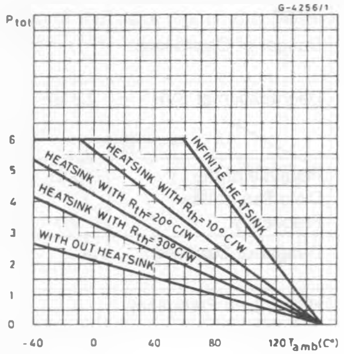


Figure 32 : Maximum Allowable Power Dissipation vs. Ambient Temperature.



MOUNTING INSTRUCTION : See TDA1904.