SGS-THOMSON MICROELECTRONICS

TDA1905

5W AUDIO AMPLIFIER WITH MUTING

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).

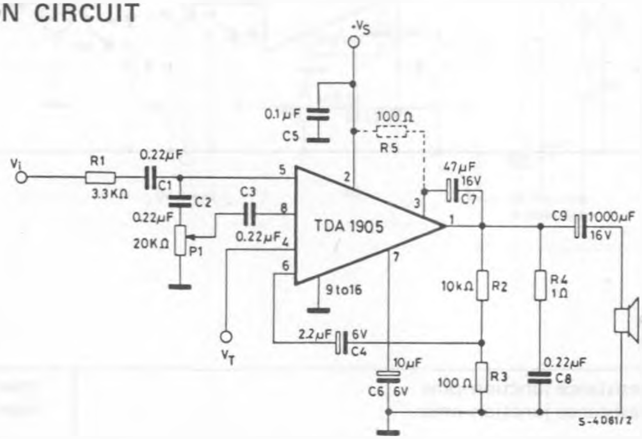
Powerdip
(8 + 8)

ORDERING NUMBER: TDA1905

ABSOLUTE MAXIMUM RATINGS

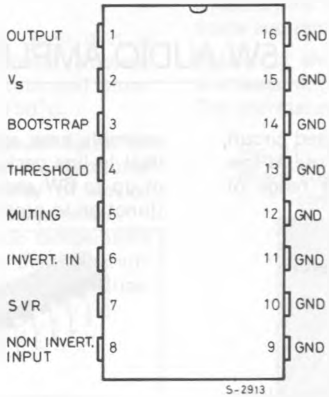
V_s	Supply voltage	30	V
I_o	Output peak current (non repetitive)	3	A
I_o	Output peak current (repetitive)	2.5	A
V_i	Input voltage	0 to + V_s	V
V_i	Differential input voltage	± 7	V
V_{11}	Muting thresold voltage	V_s	V
P_{tot}	Power dissipation at T_{amb} = 80°C	1	W
	T_{case} = 60°C	6	W
T_{stg}, T_j	Storage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

APPLICATION CIRCUIT

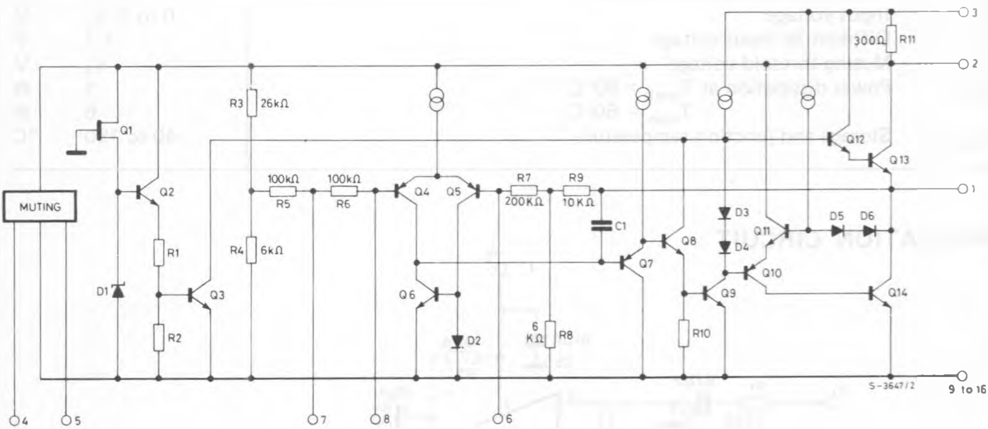


CONNECTION DIAGRAM

(Top view)



SCHEMATIC DIAGRAM

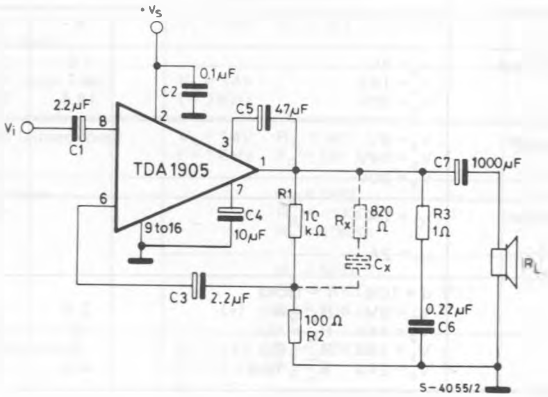


THERMAL DATA

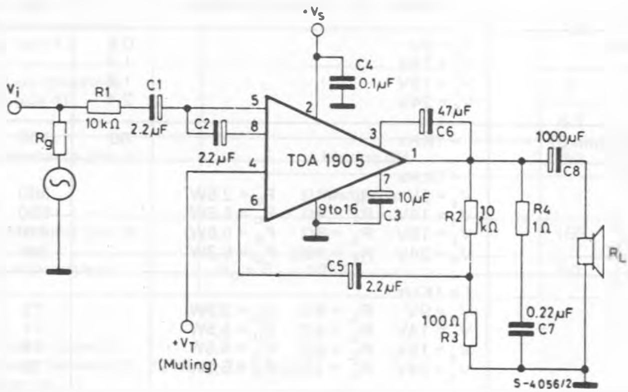
$R_{thj\text{-}case}$	Thermal resistance junction-pins	max	15	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-amb	max	70	°C/W

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)

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

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

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
BW	Small signal bandwidth (-3dB)	V_s = 14V R_L = 4Ω 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 = 4Ω f = 1KHz P_o = 1W		39.5	40	40.5	dB
e_N	Total input noise		R_g = 50Ω R_g = 1KΩ (°) R_g = 10KΩ		1.2 1.3 1.5	4.0	μV
			R_g = 50Ω R_g = 1KΩ (°°) R_g = 10KΩ		2.0 2.0 2.2	6.0	μV
S/N	Signal to noise ratio	V_s = 14V P_o = 5.5W R_L= 4Ω	R_g = 10KΩ R_g = 0 (°)		90 92		dB
			R_g = 10KΩ R_g = 0 (°°)		87 87		dB
SVR	Supply voltage rejection	V_s = 18V R_L = 8Ω f_{ripple} = 100 Hz R_g = 10KΩ V_{ripple} = 0.5Vrms		40	50		dB
T_{sd}	Thermal shut-down case temperature (*)	P_{tot} = 2.5W			115		°C

MUTING FUNCTION

			Min.	Typ.	Max.	Unit
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	$R_g + R_1$ = 10KΩ	50	60		dB

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

Fig. 1 - Quiescent output voltage vs. supply voltage

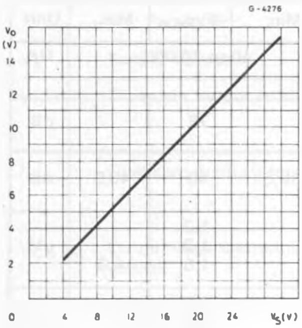


Fig. 2 - Quiescent drain current vs. supply voltage

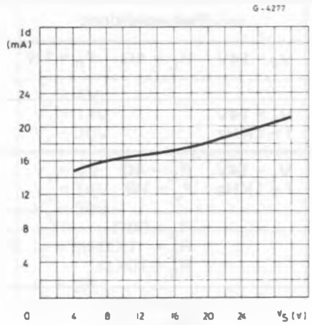


Fig. 3 - Output power vs. supply voltage

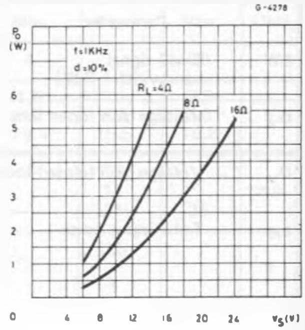


Fig. 4 - Distortion vs. output power ($R_L = 16\Omega$)

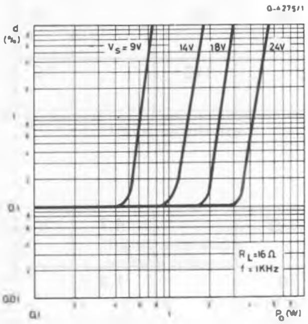


Fig. 5 - Distortion vs. output power ($R_L = 8\Omega$)

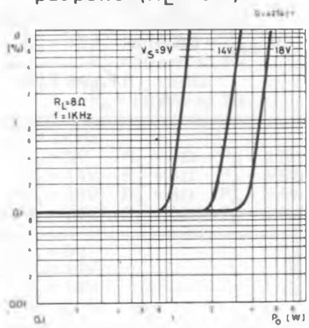


Fig. 6 - Distortion vs. output power ($R_L = 4\Omega$)

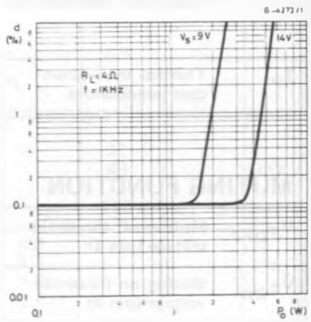


Fig. 7 - Distortion vs. frequency ($R_L = 16\Omega$)

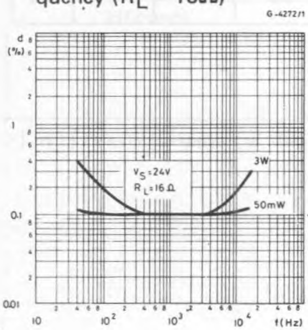


Fig. 8 - Distortion vs. frequency ($R_L = 8\Omega$)

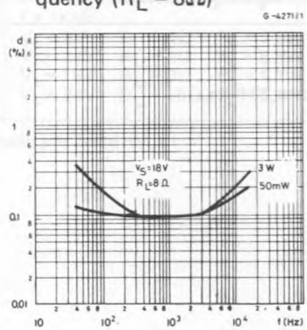


Fig. 9 - Distortion vs. frequency ($R_L = 4\Omega$)

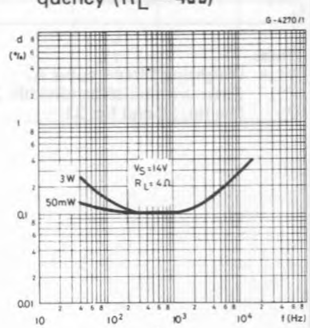


Fig. 10 - Open loop frequency response

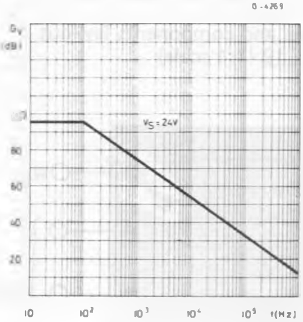


Fig. 11 - Output power vs. input voltage

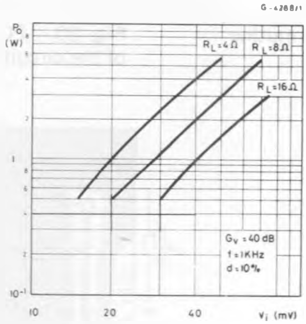


Fig. 12 - Value of capacitor Cx vs. bandwidth (BW) and gain (Gv)

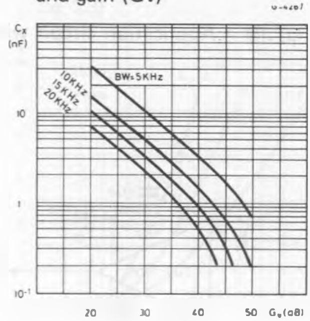


Fig. 13 - Supply voltage rejection vs. voltage gain (ref. to the Muting circuit)

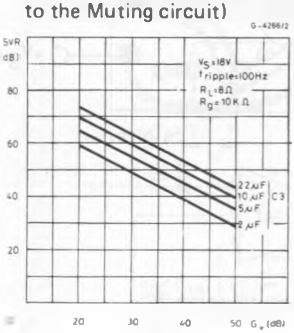


Fig. 14 - Supply voltage rejection vs. source resistance

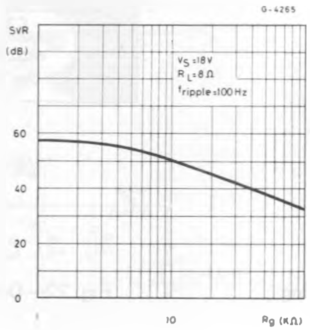


Fig. 15 - Max power dissipation vs. supply voltage (sine wave operation)

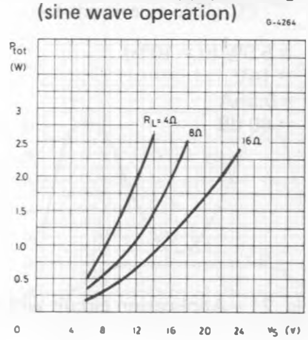


Fig. 16 - Power dissipation and efficiency vs. output power

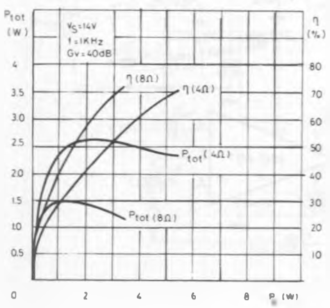


Fig. 17 - Power dissipation and efficiency vs. output power

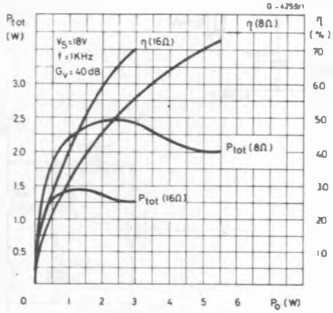
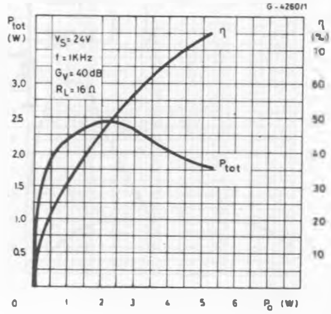
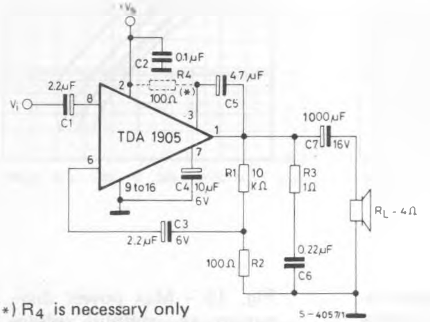


Fig. 18 - Power dissipation and efficiency vs. output power



APPLICATION INFORMATION

Fig. 19 - Application circuit without muting



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

$P_o = 5.5W$ (d = 10%)
$V_s = 14V$
$I_d = 0.55A$
$G_v = 40$ dB

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

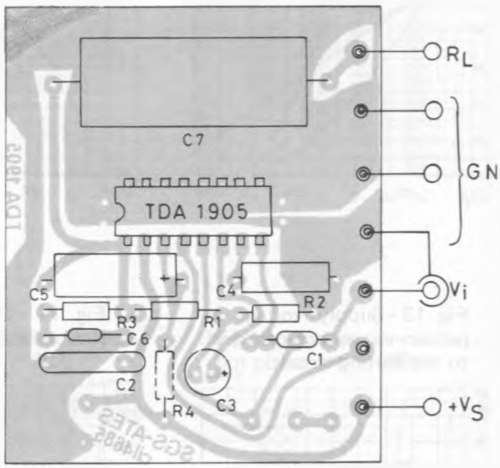


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Fig. 21 - Application circuit with muting

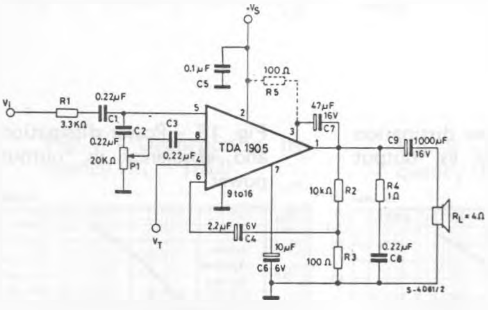
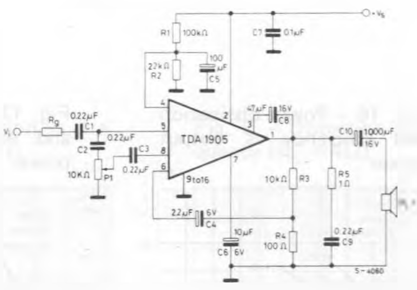


Fig. 22 - Delayed muting circuit



APPLICATION INFORMATION (continued)

Fig. 23 - Low-cost application circuit without bootstrap.

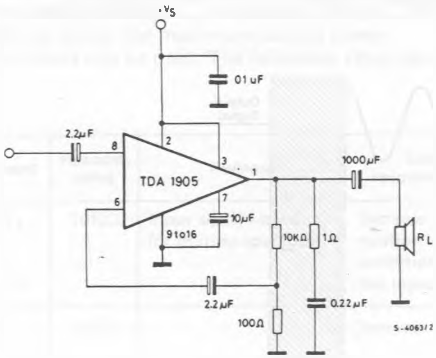


Fig. 24 - Output power vs. supply voltage (circuit of fig. 23)

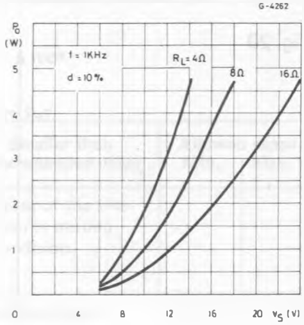


Fig. 25 - Two position DC tone control using change of pin 5 resistance (muting function)

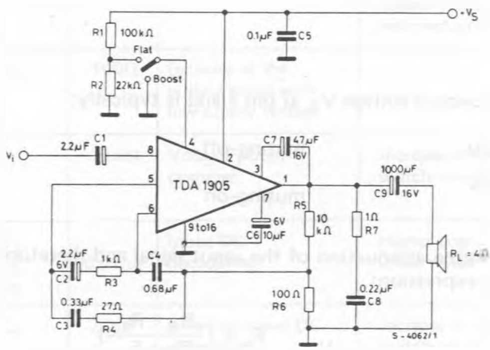


Fig. 26 - Frequency response of the circuit of fig. 25

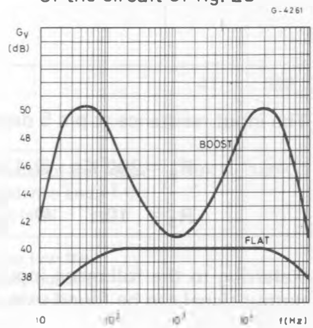


Fig. 27 - Bass Bomb tone control using change of pin 5 resistance (muting function)

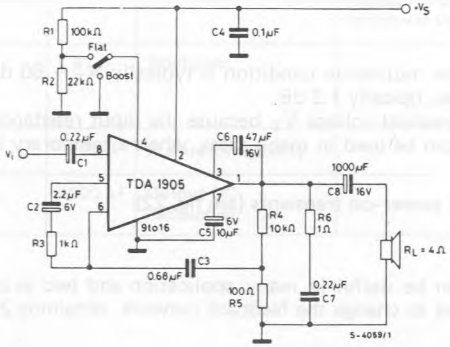
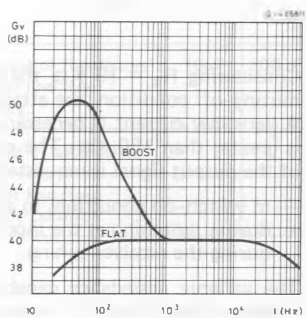


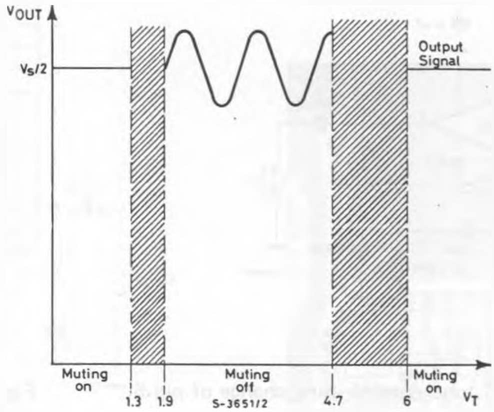
Fig. 28 - Frequency response of the circuit of fig. 27



MUTING FUNCTION

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

Fig. 29

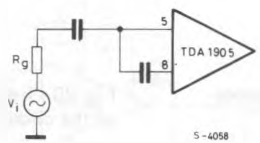


The input resistance at pin 5 depends on the threshold voltage V_T at pin 4 and is typically:

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

$R_5 = 10\Omega$ @ $0V \leqslant V_T \leqslant 1.3V$, $6V \leqslant V_T \leqslant V_s$ 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, tipically 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 10V, a 100Ω 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.
$R_g + R_1$	10KΩ	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	10KΩ	Feedback resistors	Increase of gain.	Decrease of gain. Increase quiescent current.	9 R_3	
R_3	100Ω	Feedback resistors	Decrease of gain.	Increase of gain.		1KΩ
R_4	1Ω	Frequency stability	Danger of oscillation at high frequencies with inductive loads.			
R_5	100Ω	Increase of the output swing with low supply voltage.			47	330
P_1	20KΩ	Volume potentiometer	Increase of the switch-on noise.	Decrease of the input impedance and of the input level.	10KΩ	100KΩ
C_1 C_2 C_3	0.22 μF	Input DC decoupling.	Higher cost lower noise.	Higher low frequency cutoff. Higher noise		
C_4	2.2μF	Inverting input DC decoupling.	Increase of the switch-on noise.	Higher low frequency cutoff.	0.1μF	
C_5	0.1μF	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	47μF	Bootstrap.		Increase of the distortion at low frequency.	10μF	100μF
C_8	0.22μF	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.

Fig. 30 - Output power and drain current vs. case temperature.

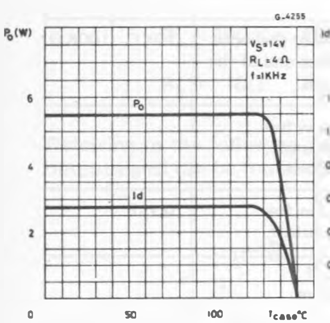


Fig. 31 - Output power and drain current vs. case temperature

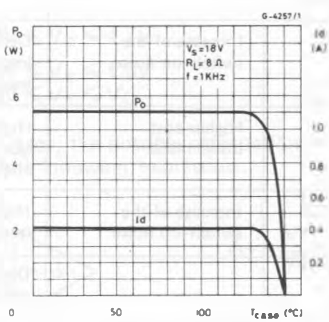
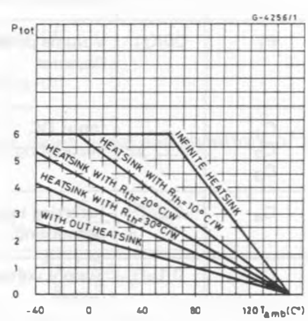


Fig. 32 - Maximum allowable power dissipation vs. ambient temperature.



MOUNTING INSTRUCTION: See TDA1904