

## 10W AUDIO AMPLIFIER WITH MUTING

### DESCRIPTION

The TDA 1910 is a monolithic integrated circuit in MULTIWATT® package, intended for use in Hi-Fi audio power applications, as high quality TV sets.

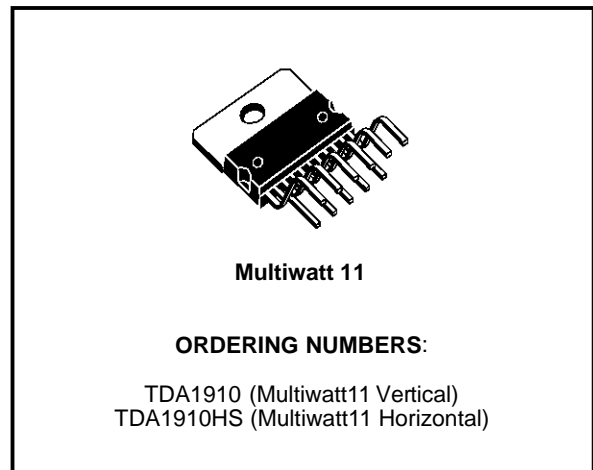
The TDA 1910 meets the DIN 45500 ( $d = 0.5\%$ ) guaranteed output power of 10W when used at 24V/4W. At 24V/8W the output power is 7W min.

Features:

- muting facility
- protection against chip over temperature
- very low noise
- high supply voltage rejection
- low "switch-on" noise.

The TDA 1910 is assembled in MULTIWATT® package that offers:

- easy assembly
- simple heatsink

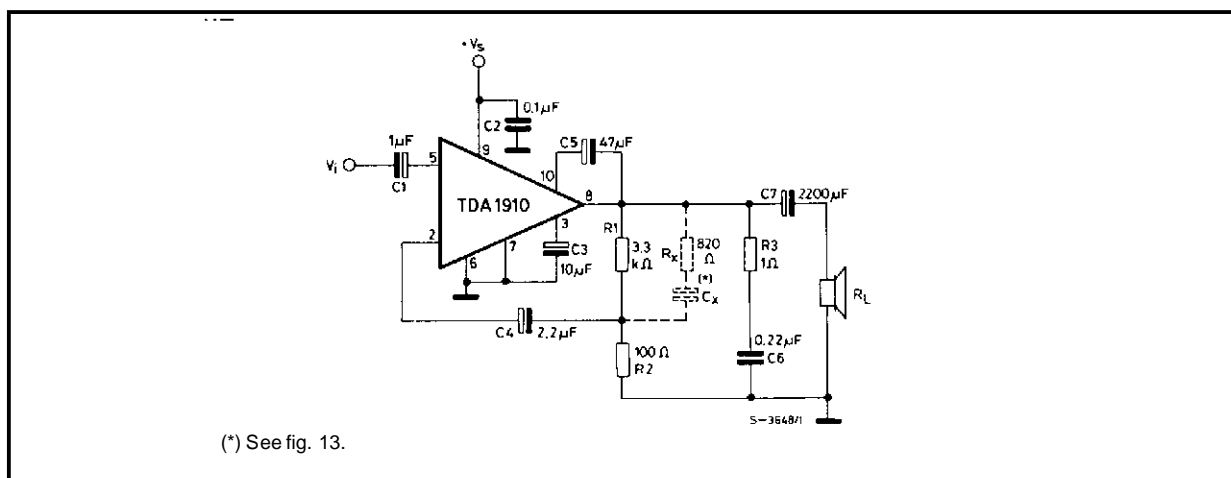


- space and cost saving
- high reliability

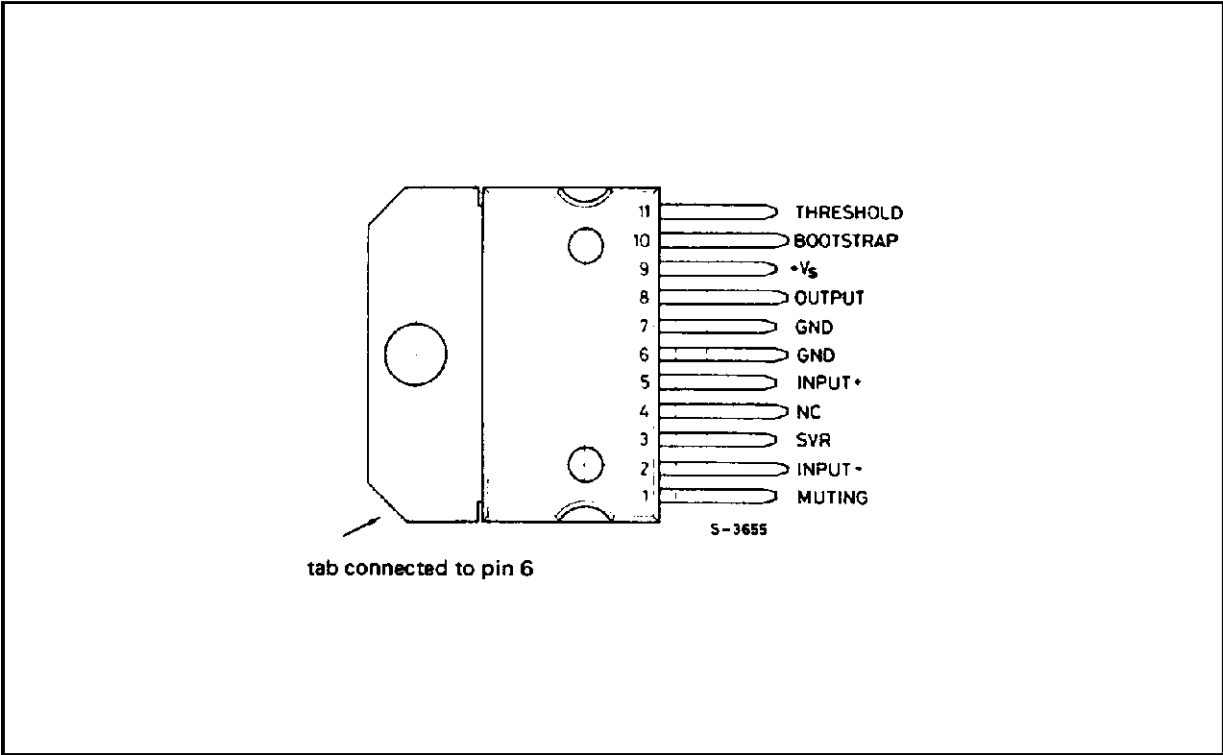
### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_s$	Supply voltage	30	V
$I_o$	Output peak current (non repetitive)	3.5	A
$I_o$	Output peak current (repetitive)	3.0	A
$V_i$	Input voltage	0 to $+V_s$	V
$V_i$	Differential input voltage	$\pm 7$	V
$V_{11}$	Muting threshold voltage	$V_s$	V
$P_{tot}$	Power dissipation at $T_{case} = 90^\circ\text{C}$	20	W
$T_{stg}, T_j$	Storage and junction temperature	-40 to 150	$^\circ\text{C}$

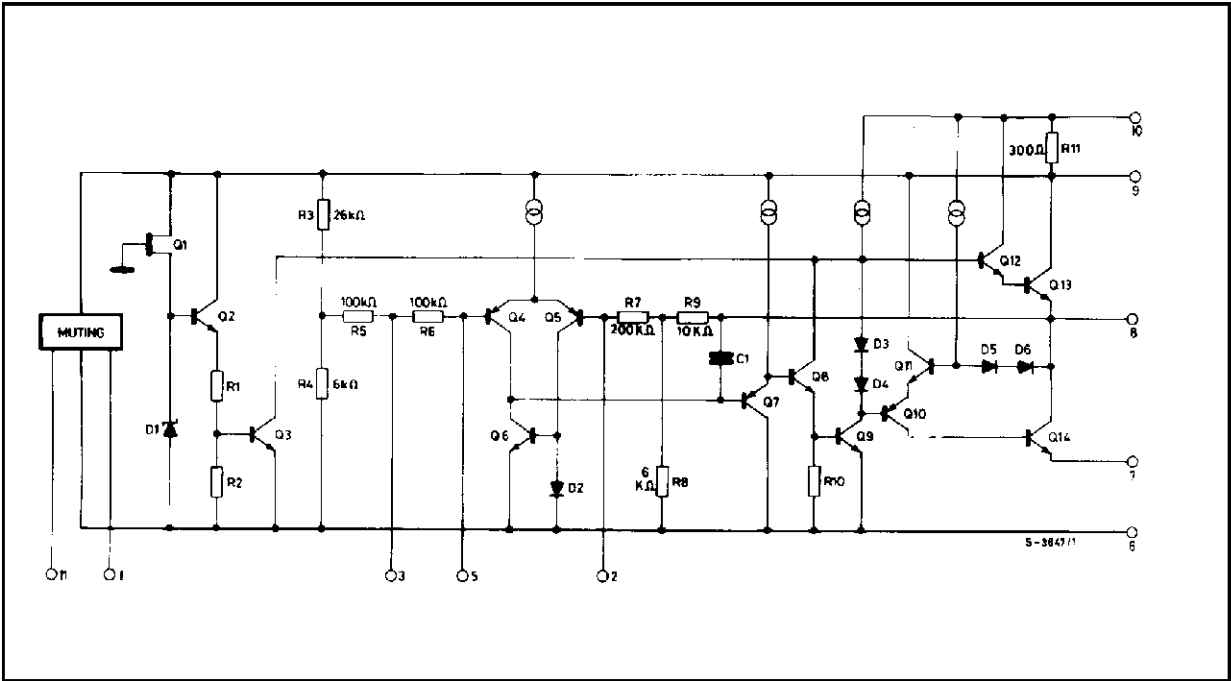
### TEST CIRCUIT



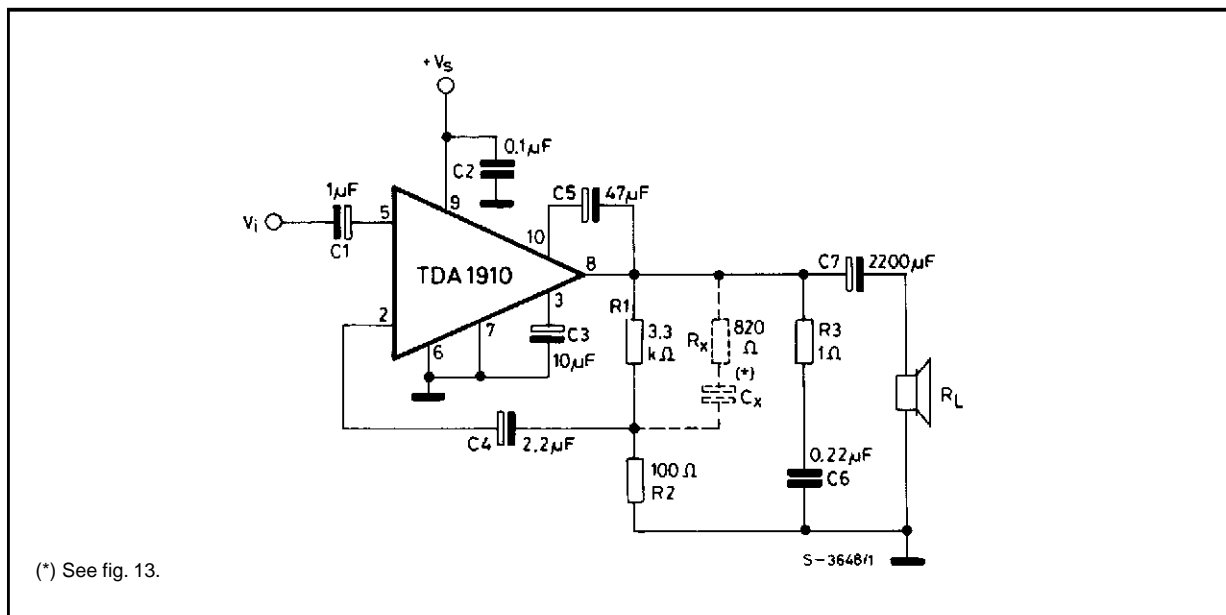
PIN CONNECTION (Top view)



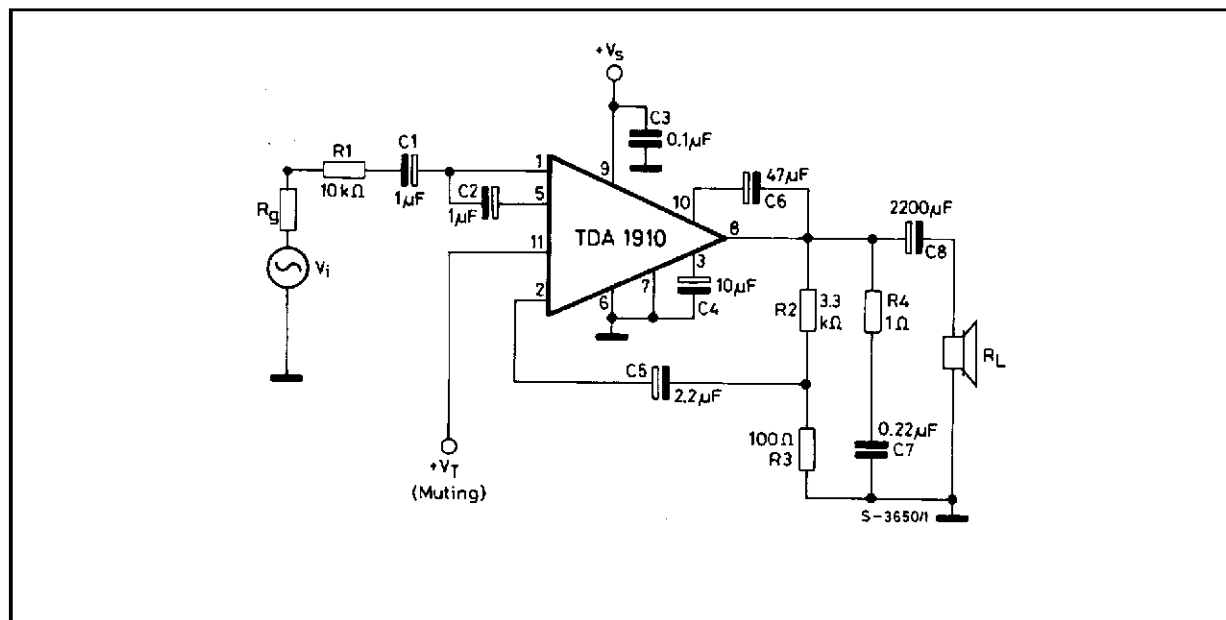
SCHEMATIC DIAGRAM



TEST CIRCUIT



MUTING CIRCUIT



## THERMAL DATA

Symbol	Parameter	Value	Unit
$R_{th\ j-case}$	Thermal resistance junction-case	max 3	°C/W

**ELECTRICAL CHARACTERISTICS** (Refer to the test circuit,  $T_{amb} = 25\text{ °C}$ ,  $R_{th}$  (heatsink) =  $4\text{ °C/W}$ , unless otherwise specified)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_s$	Supply voltage		8		30	V
$V_o$	Quiescent output voltage	$V_s = 18V$ $V_s = 24V$	8.3 11.5	9.2 12.4	10 13.4	V
$I_d$	Quiescent drain current	$V_s = 18V$ $V_s = 24V$		19 21	32 35	mA
$V_{CE\ sat}$	Output stage saturation voltage	$I_C = 2A$		1		V
		$I_C = 3A$		1.6		
$P_o$	Output power	$d = 0.5\%$ $f = 40\text{ to }15,000\text{Hz}$ $V_s = 18V$ $R_L = 4\Omega$ $V_s = 24V$ $R_L = 4\Omega$ $V_s = 24V$ $R_L = 8\Omega$	6.5 10 7	7 12 7.5		W
		$d = 10\%$ $f = 1\text{ KHz}$ $V_s = 18V$ $R_L = 4\Omega$ $V_s = 24V$ $R_L = 4\Omega$ $V_s = 24V$ $R_L = 8\Omega$	8.5 15 9	9.5 17 10		
d	Harmonic distortion	$f = 40\text{ to }15,000\text{ Hz}$ $V_s = 18V$ $R_L = 4\Omega$ $P_o = 50\text{ mW to }6.5W$		0.2	0.5	%
		$V_s = 24V$ $R_L = 4\Omega$ $P_o = 50\text{ mW to }10W$		0.2	0.5	
		$V_s = 24V$ $R_L = 8\Omega$ $P_o = 50\text{ mW to }7W$		0.2	0.5	
d	Intermodulation distortion	$V_s = 24V$ $R_L = 4\Omega$ $P_o = 10W$ $f_1 = 250\text{ Hz}$ $f_2 = 8\text{ KHz}$ (DIN 45500)		0.2		%
$V_i$	Input sensitivity	$F = 1\text{ KHz}$ , $V_s = 18V$ $R_L = 4\Omega$ $P_o = 7\text{ W}$ $V_s = 24V$ $R_L = 4\Omega$ $P_o = 12\text{ W}$ $V_s = 24V$ $R_L = 8\Omega$ $P_o = 7.5W$		170 220 245		mV
$V_i$	Input saturation voltage (rms)	$V_s = 18V$ $V_s = 24V$	1.8 2.4			V
$R_i$	Input resistance (pin 5)	$f = 1\text{ KHz}$	60	100		K $\Omega$
$I_d$	Drain current	$V_s = 24V$ $f = 1\text{ KHz}$ $R_L = 4\Omega$ $P_o = 12W$ $R_L = 8\Omega$ $P_o = 7.5W$		820 475		mA

## ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
h	Efficiency	$V_s = 24V$ $R_L = 4\Omega$ $R_L = 8\Omega$ $f = 1 \text{ KHz}$ $P_o = 12W$ $P_o = 7.5W$		62 65		%
BW	Small signal bandwidth	$V_s = 24V$ $R_L = 4\Omega$ $P_o = 1W$	10 to 120,000			Hz
BW	Power bandwidth	$V_s = 24V$ $P_o = 12W$ $R_L = 4\Omega$ $d \leq 5\%$	40 to 15,000			Hz
$G_v$	Voltage gain (open loop)	$f = 1 \text{ KHz}$		75		dB
$G_v$	Voltage gain (closed loop)	$V_s = 24V$ $f = 1 \text{ KHz}$ $R_L = 4\Omega$ $P_o = 1W$	29.5	30	30.5	dB
$e_N$	Total input noise	$R_g = 50\Omega$ $R_g = 1K\Omega$ $R_g = 10K\Omega$ ( $^\circ$ )		1.2 1.3 1.5	3.0 3.2 4.0	$\mu V$
		$R_g = 50\Omega$ $R_g = 1K\Omega$ $R_g = 10K\Omega$ ( $^{\circ\circ}$ )		2.0 2.0 2.2	5.0 5.2 6.0	$\mu V$
S/N	Signal to noise ratio	$V_s = 24V$ $P_o = 12W$ $R_L = 4\Omega$ $R_g = 10K\Omega$ $R_g = 0$ ( $^\circ$ )	97	103 105		dB
		$R_g = 10K\Omega$ $R_g = 0$ ( $^{\circ\circ}$ )	93	100 100		dB
SVR	Supply voltage rejection	$V_s = 24V$ $f_{\text{ripple}} = 100 \text{ Hz}$ $R_L = 4\Omega$ $R_g = 10 \text{ K}\Omega$	50	60		dB
$T_{sd}$	Thermal shut-down case (*) temperature	$P_{\text{tot}} = 8W$	110	125		$^\circ C$

## MUTING FUNCTION (Refer to Muting circuit)

$V_T$	Muting-off threshold voltage (pin 11)		1.9		4.7	V
$V_T$	Muting-on threshold voltage (pin 11)		0		1.3	V
			6		$V_s$	
$R_1$	Input resistance (pin 1)	Muting off	80	200		$K\Omega$
		Muting on		10	30	$\Omega$
$R_{11}$	Input resistance (pin 11)		150			$K\Omega$
$A_T$	Muting attenuation	$R_g + R_1 = 10 \text{ K}\Omega$	50	60		dB

## Note :

( $^\circ$ ) Weighting filter = curve A.

( $^\circ$   $^{\circ}$ ) Filter with noise bandwidth: 22 Hz to 22 KHz.

(\*) See fig. 29 and fig. 30.

Figure 1. Quiescent output voltage vs. supply voltage

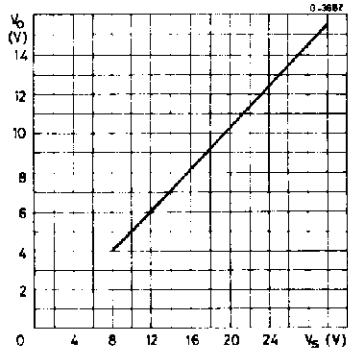


Figure 2. Quiescent drain current vs. supply voltage

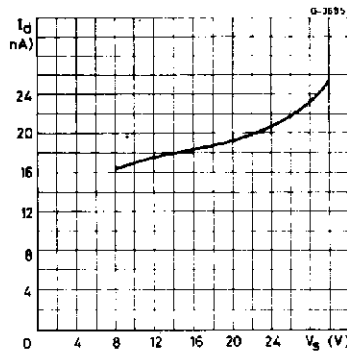


Figure 3. Open loop frequency response

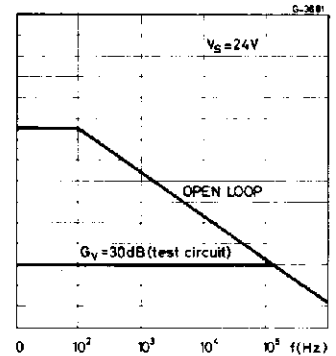


Figure 4. Output power vs. supply voltage

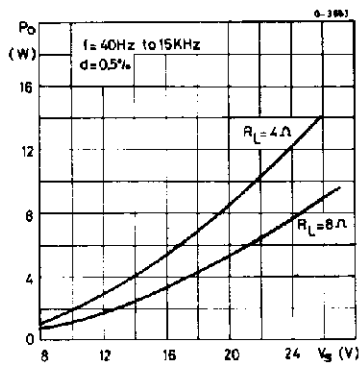


Figure 5. Output power vs. supply voltage

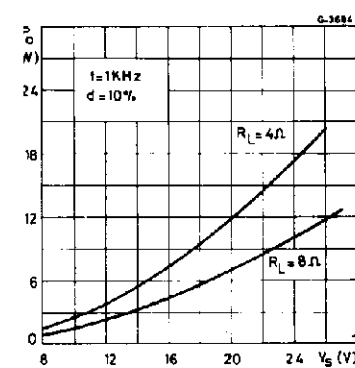


Figure 6. Distortion vs. output power

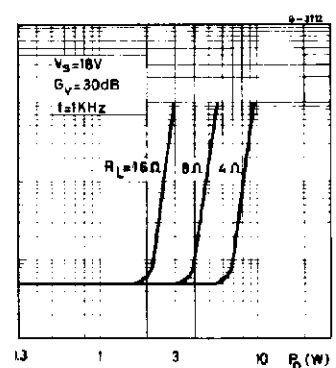


Figure 7. Distortion vs. output power

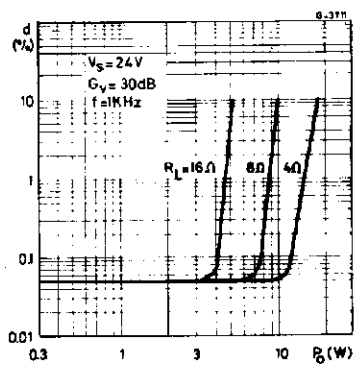


Figure 8. Output power vs. frequency

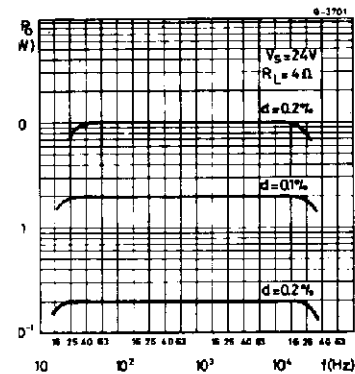


Figure 9. Output power vs. frequency

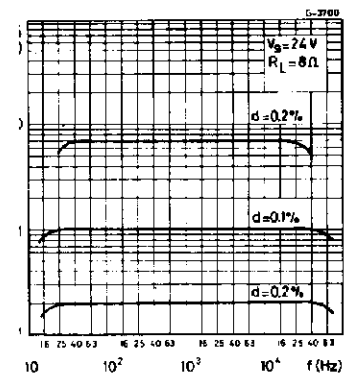


Figure 10. Output power vs. input voltage

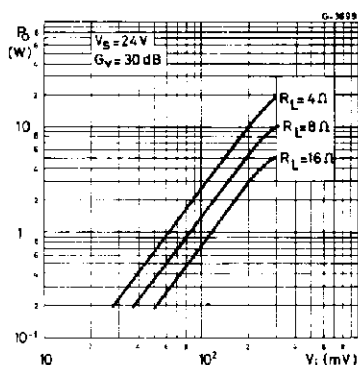


Figure 11. Output power vs. input voltage

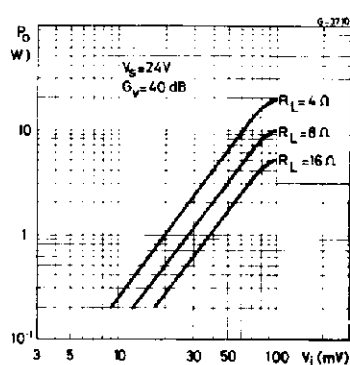


Figure 12. Total input noise vs. source resistance

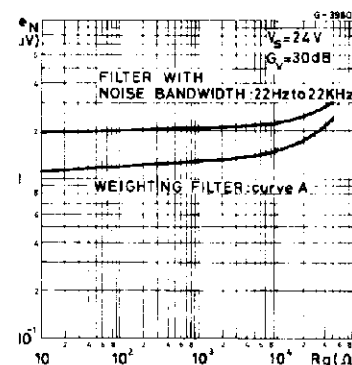


Figure 13. Values of capacitor CX vs. bandwidth (BW) and gain (Gv)

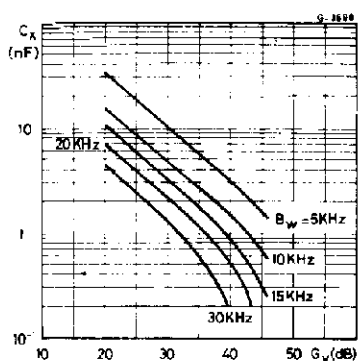


Figure 14. Supply voltage rejection vs. voltage gain

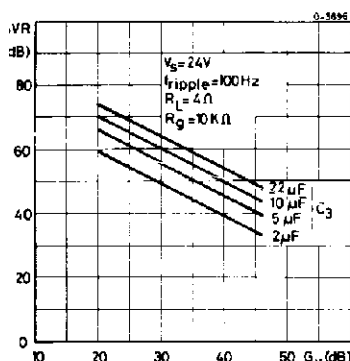


Figure 15. Supply voltage rejection vs. source resistance

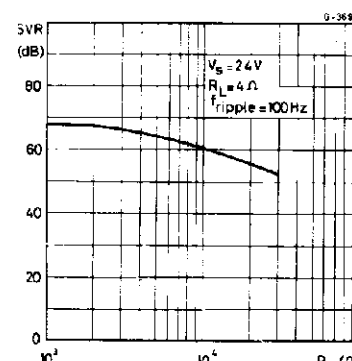


Figure 16. Power dissipation and efficiency vs. output power

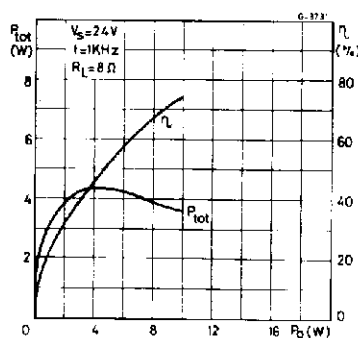


Figure 17. Power dissipation and efficiency vs. output power

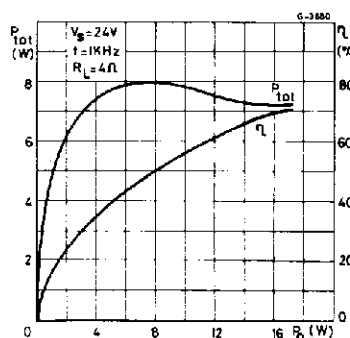
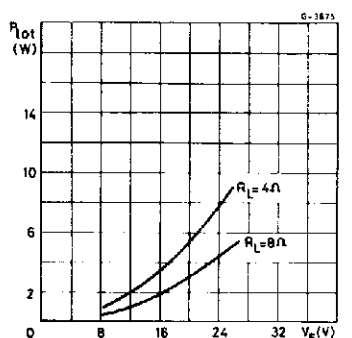


Figure 18. Max power dissipation vs. supply voltage



APPLICATION INFORMATION

Figure 19. Application circuit without muting

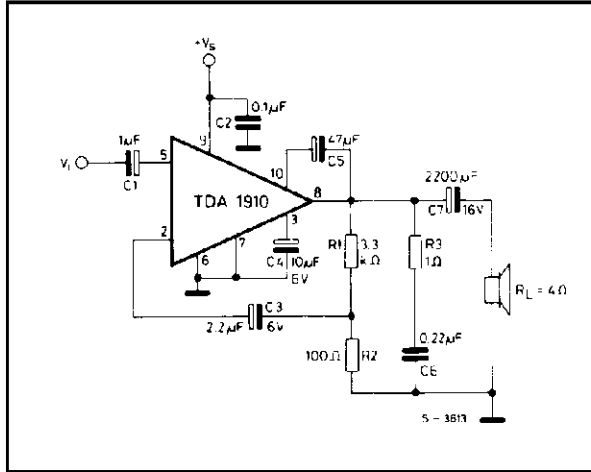


Figure 20. PC board and component lay-out of the circuit of fig. 19 (1:1 scale)

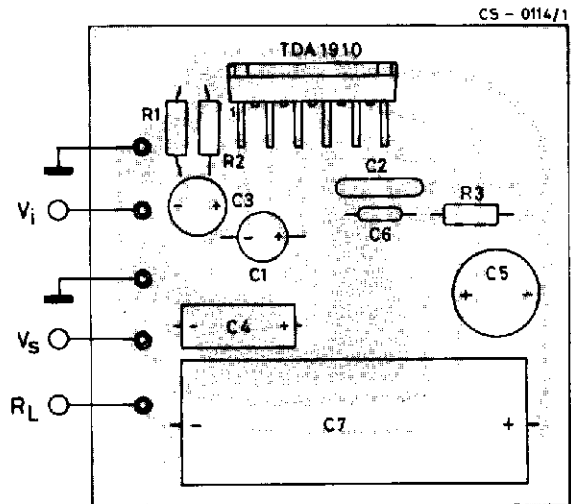
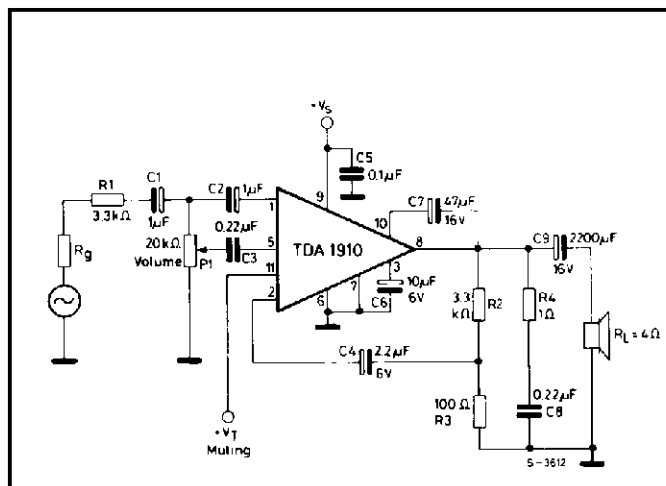


Figure 21. Application circuit with muting



Performance (circuits of fig. 19 and 21)

$P_o = 12W$  (40 to 15000 Hz,  $d \leq 0.5\%$ )

$V_s = 24V$

$I_d = 0.82A$

$G_v = 30 dB$



APPLICATION INFORMATION (continued)

Figure 22. Two position DC tone control (10 dB boost 50 Hz and 20 KHz) using change of pin 1 resistance (muting function)

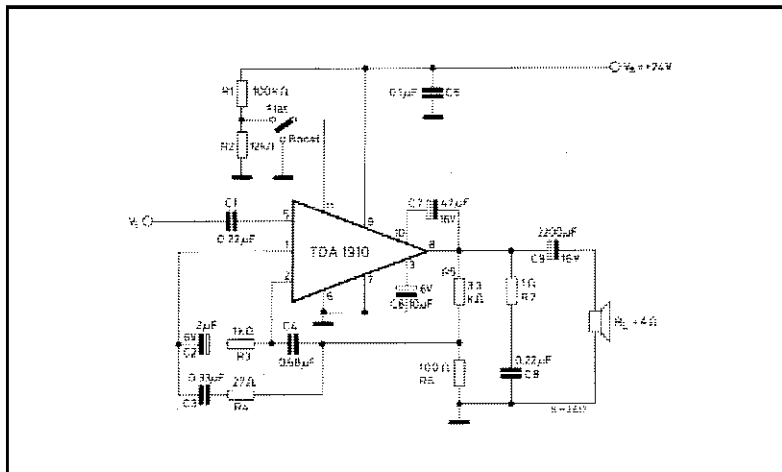


Figure 23. Frequency response of the circuit of fig. 22

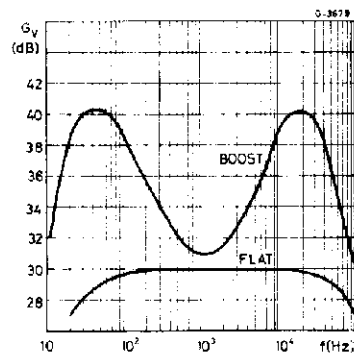


Figure 24. 10 dB 50 Hz boost tone control using change of pin 1 resistance (muting function)

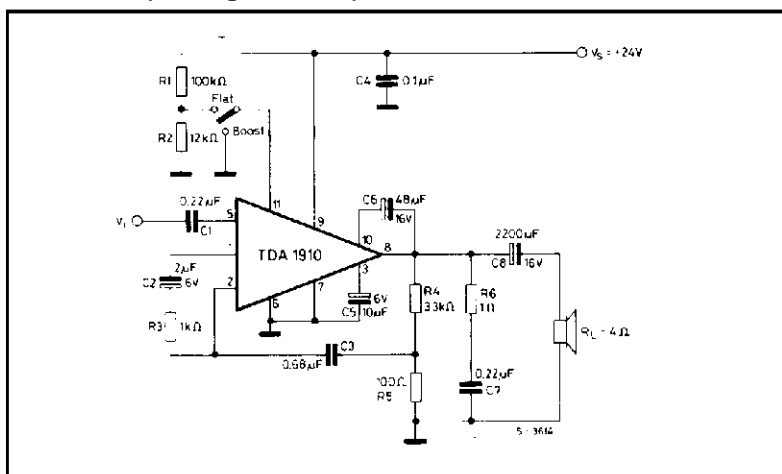


Figure 25. Frequency response of the circuit of fig. 24

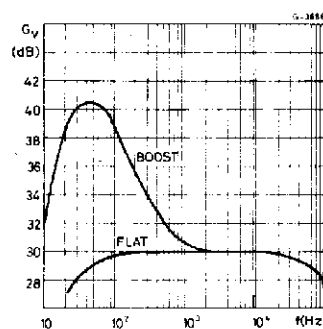


Figure 26. Squelch function in TV applications

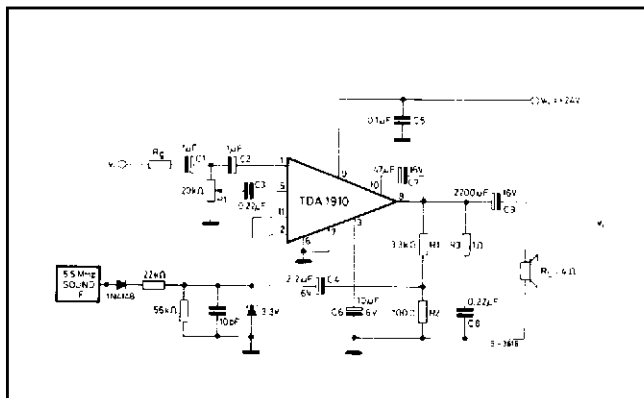
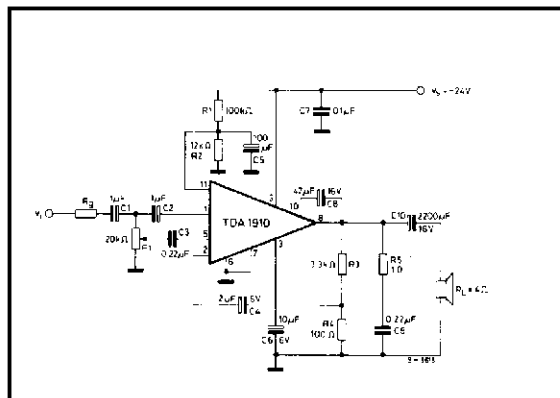


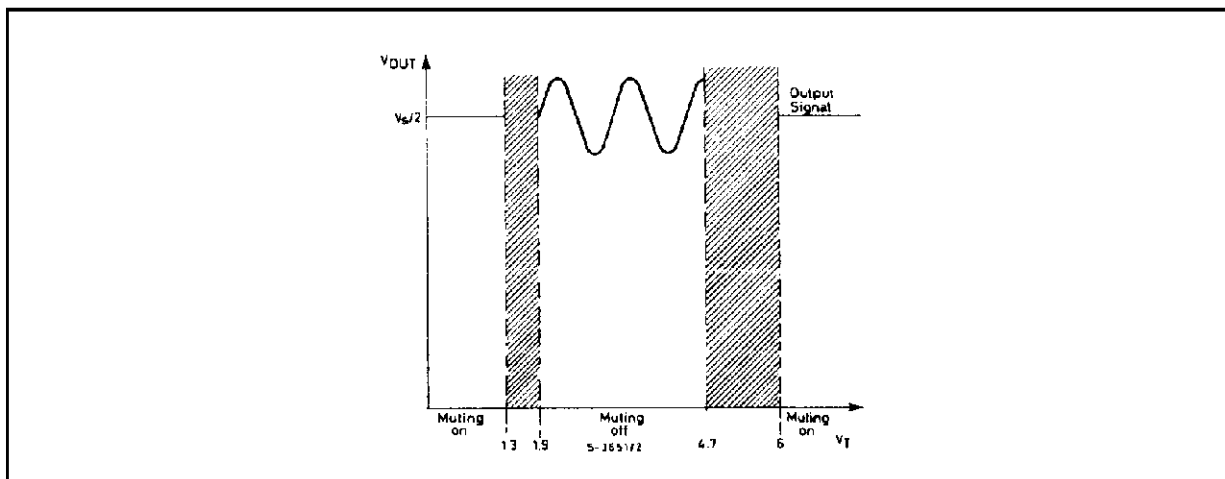
Figure 27. Delayed muting circuit



**MUTING FUNCTION**

The output signal can be inhibited applying a DC voltage  $V_T$  to pin 11, as shown in fig. 28

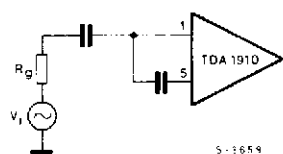
**Figure 28**



The input resistance at pin 1 depends on the threshold voltage  $V_T$  at pin 11 and is typically.

- $R_1 = 200\text{ K}\Omega$  @  $1.9\text{ V} \leq V_T \leq 4.7\text{ V}$  muting-off
- $R_1 = 10\ \Omega$  @  $0\text{ V} \leq V_T \leq 1.3\text{ V}$  muting-on
- @  $6\text{ V} \leq V_T \leq V_s$

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.



$$A_T = \frac{V_i}{V_5} = \frac{R_g + R_5 // R_1}{R_5 // R_1}$$

where  $R_5 \cong 100\text{ K}\Omega$

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 11 is greater than 150 K $\Omega$ . 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. 27)

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

The variable impedance capability at pin 1 can be useful in many applications and we have shown 2 examples in fig. 22 and 24, where it has been used to change the feedback network, obtaining 2 different frequency responses.

### APPLICATION SUGGESTION

The recommended values of the components are those shown on application circuit of fig. 21. 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 $\Omega$	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.		
$R_2$	3.3K $\Omega$	Close loop gain setting.	Increase of gain.	Decrease of gain. Increase quiescent current.	$9 R_3$	
$R_3$	100 $\Omega$	Close loop gain setting.	Decrease of gain.	Increase of gain.		$R_2/9$
$R_4$	1 $\Omega$	Frequency stability	Danger of oscillation at high frequencies with inductive loads.			
$P_1$	20K $\Omega$	Volume potentiometer.	Increase of the switch-on noise.	Decrease of the input impedance and of the input level.	10K $\Omega$	100K $\Omega$
$C_1$ $C_2$ $C_3$	1 $\mu$ F 1 $\mu$ F 0.22 $\mu$ F	Input DC decoupling.		Higher low frequency cutoff.		
$C_4$	2.2 $\mu$ F	Inverting input DC decoupling.	Increase of the switch-on noise.	Higher low frequency cutoff.	0.1 $\mu$ F	
$C_5$	0.1 $\mu$ F	Supply voltage bypass.		Danger of oscillations.		
$C_6$	10 $\mu$ F	Ripple rejection.	Increase of SVR. Increase of the switch-on time	Degradation of SVR	2.2 $\mu$ F	100 $\mu$ F
$C_7$	47 $\mu$ F	Bootstrap.		Increase of the distortion at low frequency.	10 $\mu$ F	100 $\mu$ F
$C_8$	0.22 $\mu$ F	Frequency stability.		Danger of oscillation.		
$C_9$	2200 $\mu$ F ( $R_L = 4\Omega$ ) 1000 $\mu$ F ( $R_L = 8\Omega$ )	Output DC decoupling.		Higher low frequency cutoff.		

**THERMAL SHUT-DOWN**

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

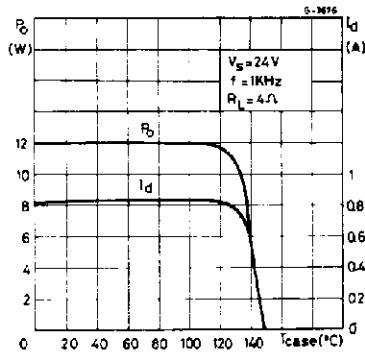
- 1) An overload on the output (even if it is permanent), or an above limit ambient temperature can be easily supported since the  $T_j$  cannot be higher than  $150^{\circ}\text{C}$ .
- 2) The heatsink can have a smaller factor of safety compared with that of a conventional

circuit. There is no possibility of device damage due to high junction temperature.

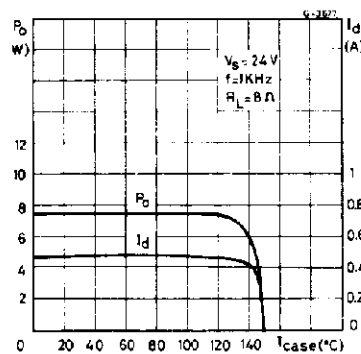
If for any reason, the junction temperature increases up to  $150^{\circ}\text{C}$ , the thermal shut-down simply reduces the power dissipation and the current consumption.

The maximum allowable power dissipation depends upon the size of the external heatsink (i.e. its thermal resistance); fig. 31 shows this dissipable power as a function of ambient temperature for different thermal resistance.

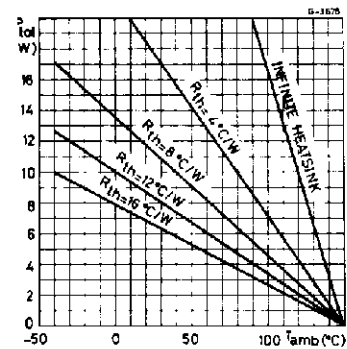
**Figure 29. Output power and drain current vs. case temperature**



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



**Figure 31. Maximum allowable power dissipation vs. ambient temperature**



**MOUNTING INSTRUCTIONS**

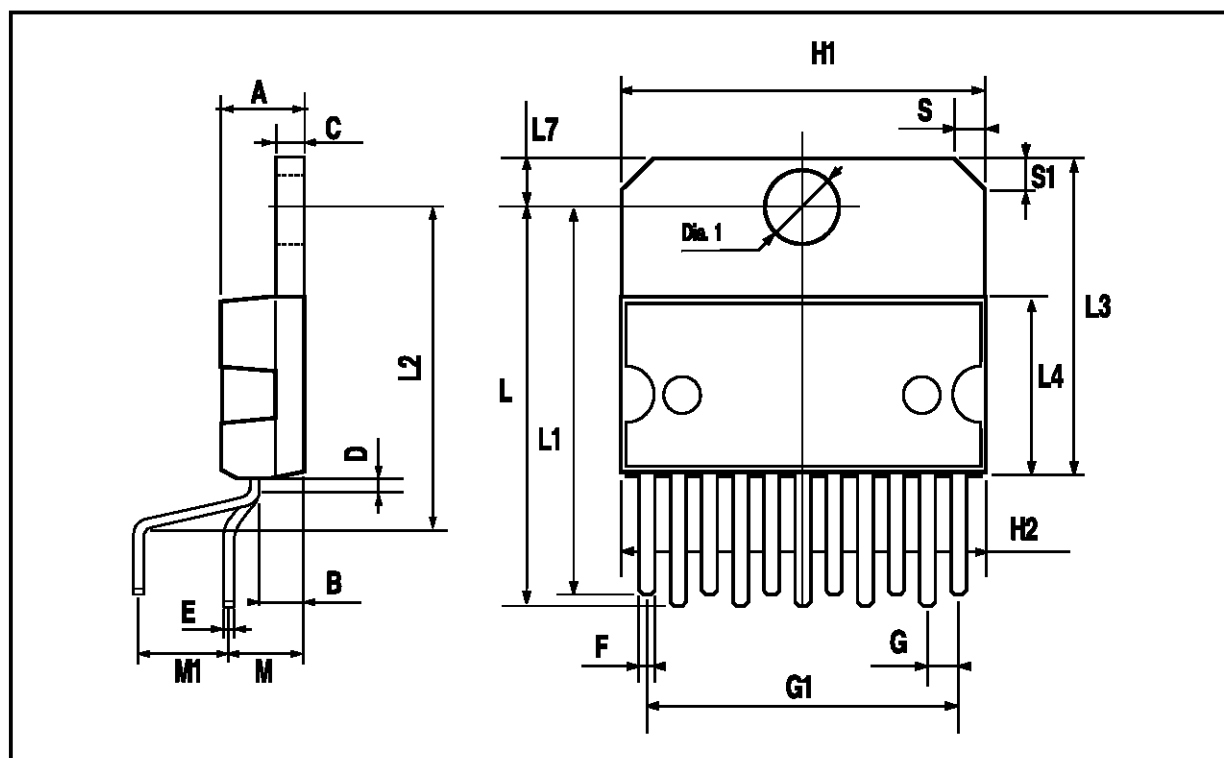
The power dissipated in the circuit must be removed by adding an external heatsink.

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 surfaces.

## MULTIWATT 11 VERTICAL PACKAGE MECHANICAL DATA

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	1.57	1.7	1.83	0.062	0.067	0.072
G1	16.87	17	17.13	0.664	0.669	0.674
H1	19.6			0.772		
H2			20.2			0.795
L	21.5		22.3	0.846		0.878
L1	21.4		22.2	0.843		0.874
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	4.1	4.3	4.5	0.161	0.169	0.177
M1	4.88	5.08	5.3	0.192	0.200	0.209
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



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