TDA2010

LINEAR INTEGRATED CIRCUIT

12W Hi-Fi AUDIO AMPLIFIER

The TDA 2010 is a monolithic integrated operational amplifier in a 14-lead quad in-line plastic package, inteded for use as a low frequency class B power amplifier. Typically it provides 12W output power (d = 1%) at ± 14V/4Ω; at V_s = ± 14V the guaranteed output power is 10W on a 4Ω load and 8W on a 8Ω load (DIN norm 45500). The TDA 2010 provides high output current (up to 3.5 A) and has very low harmonic and cross-over distortion. Further, the device incorporates an original (and patented) short circuit protection system, comprising an arrangement for automatically limiting the dissipated power so as to keep to working point of the output transistors within their safe operating area. A conventional thermal shut-down system is also included. The TDA 2010 is pin to pin equivalent to TDA 2020.

ABSOLUTE MAXIMUM RATINGS

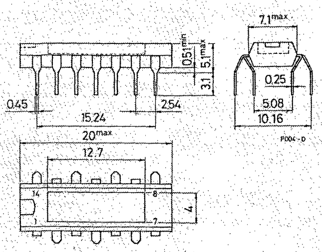
V_s	Supply voltage	± 18	V
V_i	Input voltage	V_s	
V_i	Differential input voltage	± 15	V
I_o	Output peak current (internally limited)	3.5	A
P_{tot}	Power dissipation at $T_{case} \leqslant 95°C$	18	W
T_{stg}, T_j	Storage and junction temperature	-40 to 150	°C

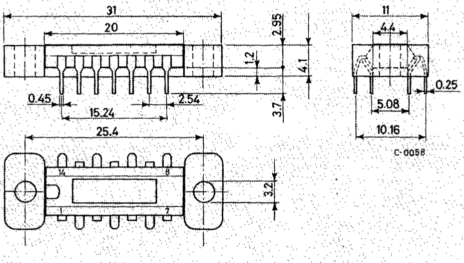
ORDERING NUMERS:

TDA 2010 B82	dual in-line plastic package
TDA 2010 B92	quad in-line plastic package
TDA 2010 BC2	dual in-line plastic package with spacer
TDA 2010 BD2	quad in-line plastic package with spacer

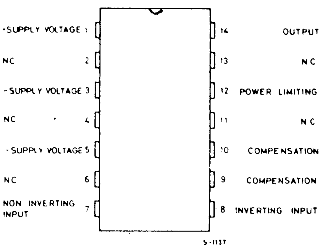
MECHANICAL DATA

Dimensions in mm

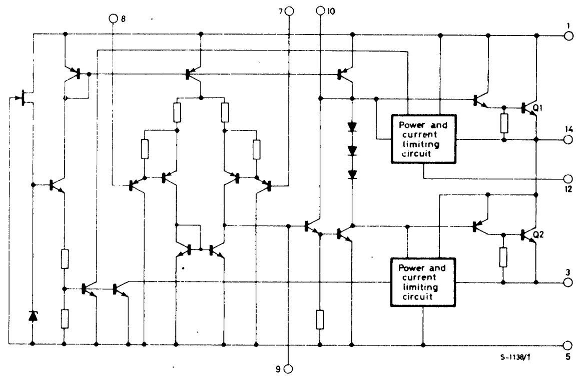




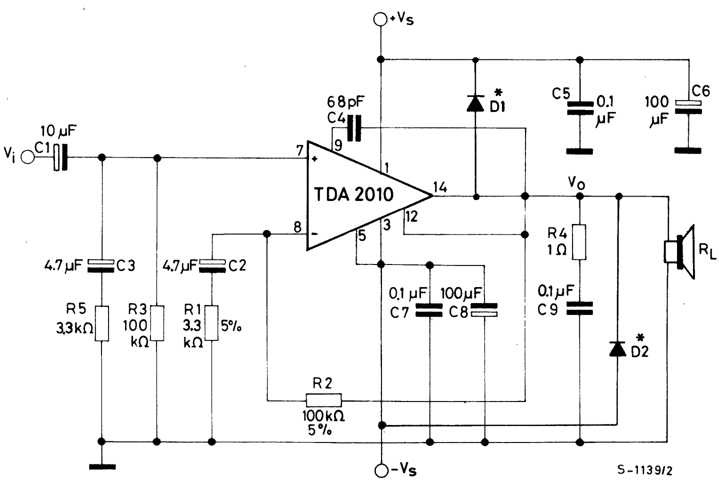
CONNECTION AND SCHEMATIC DIAGRAMS
(top view)



The copper slug is electrically connected to pin 5 (substrate)



TEST CIRCUIT



*1N 4001 OR EQUIVALENT

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	3	°C/W

ELECTRICAL CHARACTERISTICS

(Refer to the test circuit, $V_s = \pm 14V$, $T_{amb} = 25°C$ unless otherwise specified)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_s	Supply voltage		± 5		± 18	V
I_d	Quiescent drain current	$V_s = \pm 18V$		45		mA
I_b	Input bias current	$V_s = \pm 17V$		0.15		μA
V_{os}	Input offset voltage	$V_s = \pm 17V$		5		mV
I_{os}	Input offset current	$V_s = \pm 17V$		0.05		μA
V_{os}	Output offset voltage	$V_s = \pm 17V$		10	100	mV
P_o	Output power	d = 1% $T_{case} \leq 70°C$ f = 40 to 15 000 Hz $R_L = 4\ \Omega$ $R_L = 8\ \Omega$	 10 8	 12 9		 W W
		d = 10% $T_{case} \leq 70°C$ f = 1 kHz $R_L = 4\ \Omega$ $R_L = 8\ \Omega$		 15 12		 W W
V_i	Input sensitivity	f = 1 kHz $P_o = 10$ W $R_L = 4\ \Omega$ $P_o = 8$ W $R_L = 8\ \Omega$		 220 250		 mV mV
B	Frequency response (-3dB)	$R_L = 4\ \Omega$ C4 = 68 pF		10 to 160 000		Hz
d	Distortion	P_o = 100 mW to 10 W $R_L = 4\ \Omega$ $T_{case} \leq 70°C$ f = 1 kHz f = 40 to 15 000 Hz		 0.1 0.3	 1	 % %
		P_o = 100 mW to 8 W $R_L = 8\ \Omega$ $T_{case} \leq 70°C$ f = 1 kHz f = 40 to 15 000 Hz		 0.1 0.2	 1	 % %
R_i	Input resistance (pin 7)			5		MΩ
G_v	Voltage gain (open loop)	$R_L = 4\ \Omega$ f = 1 kHz		100		dB
G_v	Voltage gain (closed loop)	$R_L = 4\ \Omega$ f = 1 kHz	29.5	30	30.5	dB
e_N	Input noise voltage	$R_L = 4\ \Omega$		4		μV
i_N	Input noise current	B (-3 dB) = 22 Hz to 22 KHz		0.1		nA

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
SVR	Supply voltage rejection	$R_L = 4\ \Omega$ $f_{ripple} = 100$ Hz		50		dB
I_d	Drain current	$P_o = 12$ W $R_L = 4\ \Omega$ $P_o = 9$ W $R_L = 8\ \Omega$		0.8 0.5		A A
T_{sd}	Thermal shut-down junction temperature			145		°C
T_{sd}	(*) Thermal shut-down case temperature	$P_{tot} = 10.5$ W		120		°C

(*) See fig. 14.

Fig. 1 - Output power vs. supply voltage

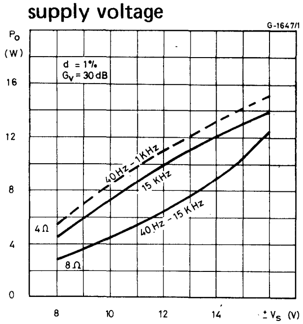


Fig. 2 - Output power vs. supply voltage

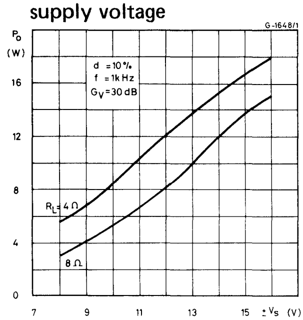


Fig. 3 - Distortion vs. output power

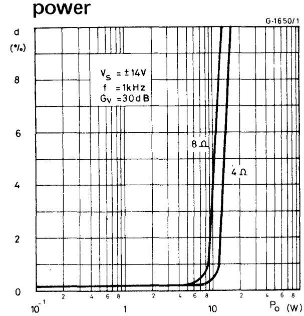


Fig. 4 - Distortion vs. output power ($R_L = 4\ \Omega$)

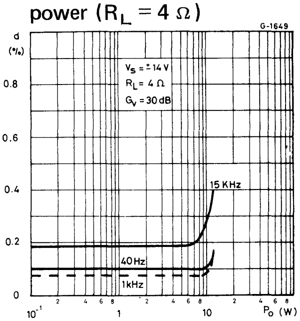


Fig. 5 - Distortion vs. output power ($R_L = 8\ \Omega$)

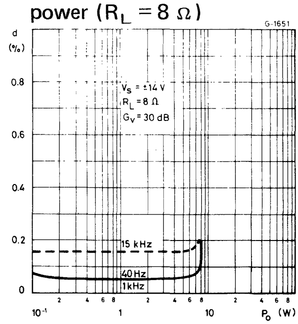


Fig. 6 - Distortion vs. frequency

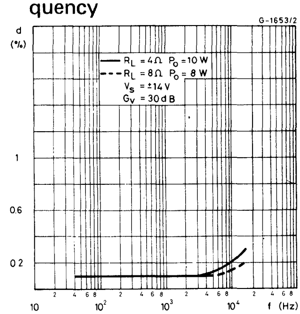


Fig. 7 - Output power vs. frequency

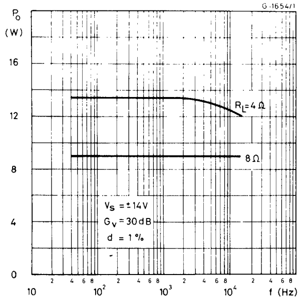


Fig. 8 - Sensitivity vs. output power ($R_L = 4\ \Omega$)

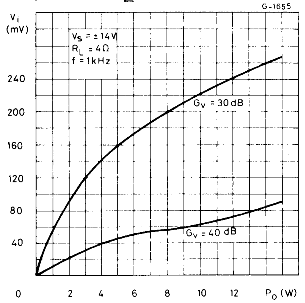


Fig. 9 - Sensitivity vs. output power ($R_L = 8\ \Omega$)

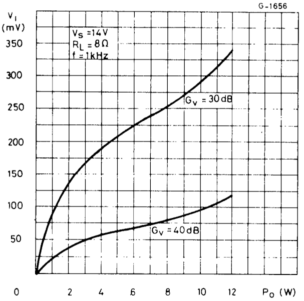


Fig. 10 - Open loop frequency response with different values of the rolloff capacitor C4

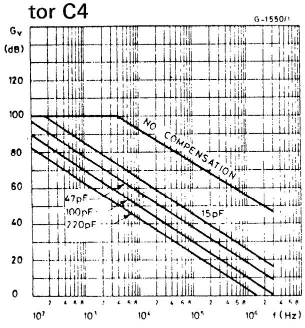


Fig. 11 - Value of C4 vs. voltage gain for different bandwidths

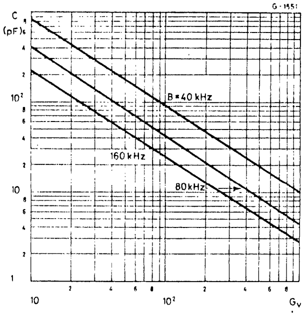


Fig. 12 - Quiescent current vs. supply voltage

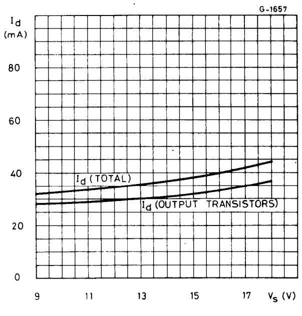


Fig. 13 - Supply voltage rejection vs. voltage gain

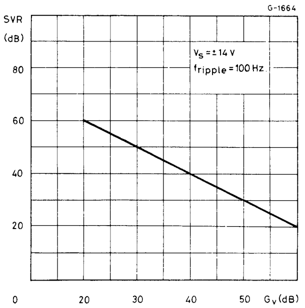


Fig. 14 - Power dissipation and efficiency vs. output power

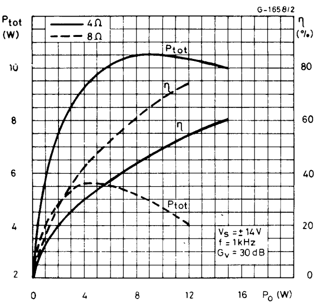
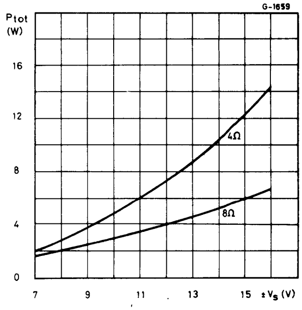


Fig. 15 - Maximum power dissipation vs. supply voltage (sine wave operation)



APPLICATION INFORMATION

Fig. 16 - Application circuit with split power supply

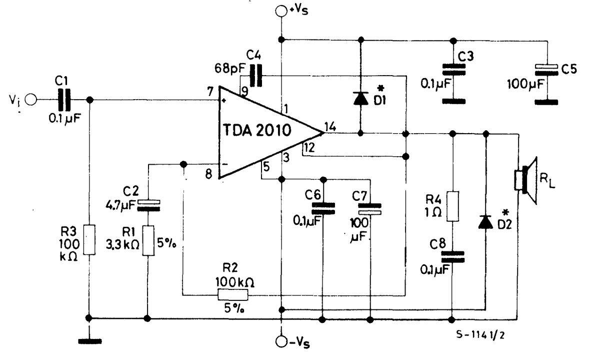
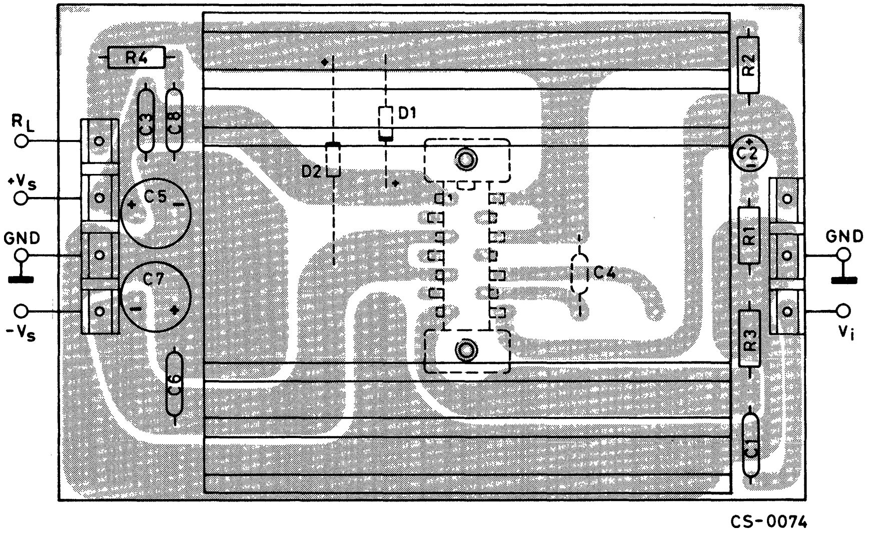


Fig. 17 - P.C. board and component layout for the circuit of fig. 16 (1:1 scale)



SHORT CIRCUIT PROTECTION

The most important innovation in the TDA 2010 is an original circuit which limits the current of the output transistors. Fig. 18 shows that the maximum output current is a function of the collector-emitter voltage; hence the output transistors work within their safe operating area (fig. 19). This function can therefore be considered as being peak power limiting rather than simple current limiting. The TDA 2010 is thus protected against temporary overloads or short circuit. Should the short circuit exists for a longer time, the thermal shut-down comes into action and keeps the junction temperature within safe limits.

Fig. 18 - Maximum output current vs. voltave (V_{CE}) across each output transistor

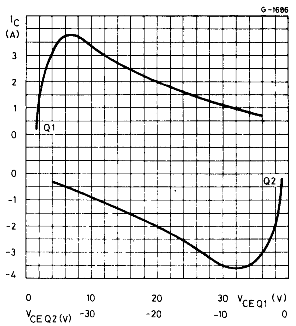
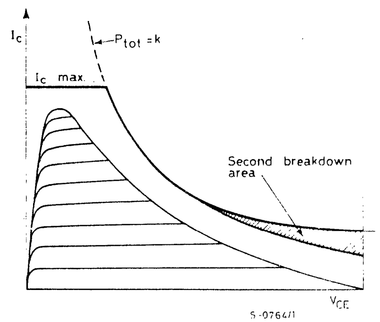


Fig. 19 - Safe operating area and collector characteristics of the protected power transistor.



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°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.

Fig. 20 - Output power and drain current vs. case temperature (R_L = 8 Ω)

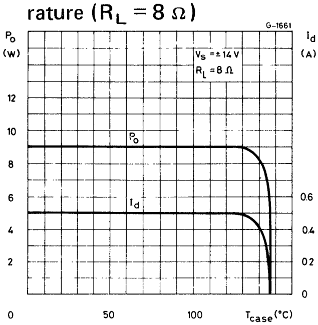
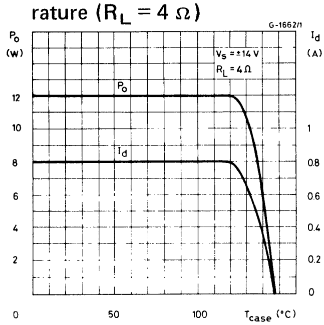


Fig. 21 - Output power and drain current vs. case temperature (R_L = 4 Ω)



MOUNTING INSTRUCTIONS

The power dissipated in the circuit must be removed by adding an external heatsink as shown in figs. 22 and 23.
The system for attaching the heatsink is very simple: it uses a plastic spacer which is supplied with the device.
Thermal contact between the copper slug (of the package) and the heatsink is guaranteed by the pressure which the screws exert via the spacer and the printed circuit board; this is due to the particular shape of the spacer.

Note: The most negative supply voltage is connected to the copper slug, hence to the heatsink (because it is in contact with the slug).

Fig. 22 - Mounting system of TDA 2010

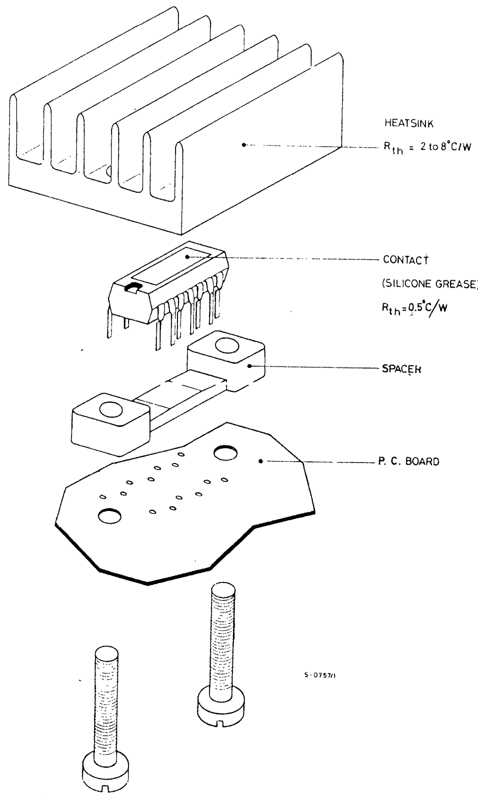
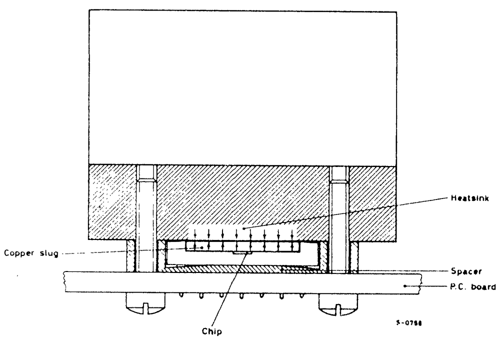


Fig. 23 - Cross-section of mounting system



The maximum allowable power dissipation depends upon the size of the external heatsink (i.e. its thermal resistance); fig. 24 shows this dissipable power as a function of ambient temperature for different thermal resistance.

Fig. 24 - Maximum allowable power dissipation vs. ambient temperature