TDA2020

LINEAR INTEGRATED CIRCUIT

20W Hi-Fi AUDIO AMPLIFIER

The TDA 2020 is a monolithic integrated **operational amplifier** in a 14-lead quad in-line plastic package, intended for use as a low frequency class B power amplifier. Typically it provides 20W output power (d = 1%) at ± 18V/4Ω; the guaranteed output power at ± 17V/4Ω is 15W (DIN norm 45500). The TDA 2020 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.

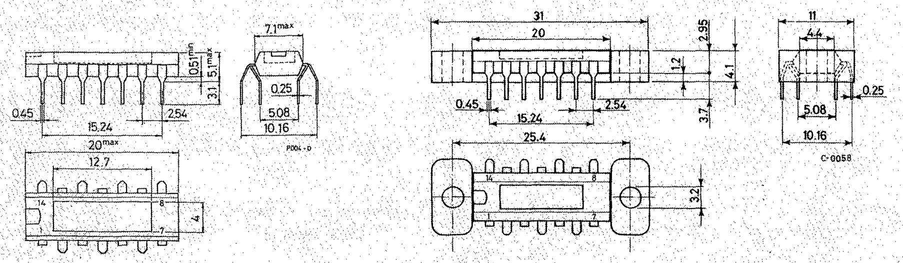
ABSOLUTE MAXIMUM RATINGS

V_s	Supply voltage	± 22	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 $T_{case} \leq 75°C$	25	W
T_{stg}, T_j	Storage and junction temperature	-40 to 150	°C

ORDERING NUMBERS: TDA 2020 A82 dual in-line plastic package
TDA 2020 A92 quad in-line plastic package
TDA 2020 AC2 dual in-line plastic package with spacer
TDA 2020 AD2 quad in-line plastic package with spacer

MECHANICAL DATA

Dimensions in mm



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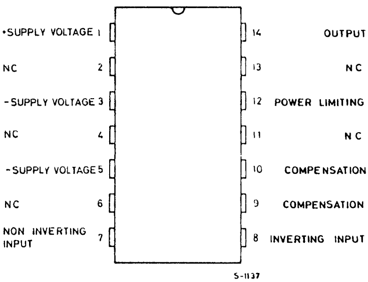
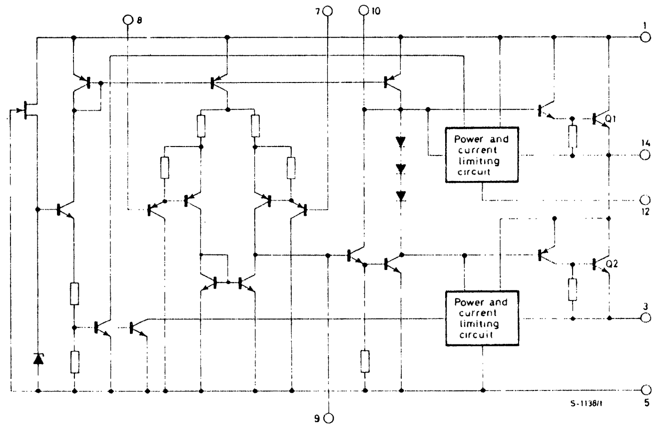
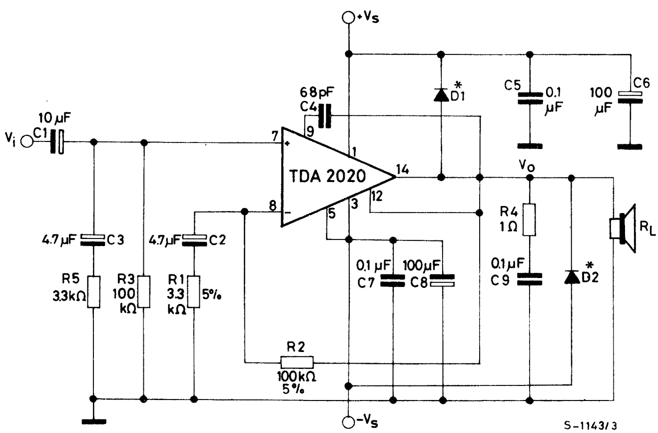
CONNECTION AND SCHEMATIC DIAGRAMS
(top view)





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

TEST CIRCUIT



*1N4001 OR EQUIVALENT

THERMAL DATA

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

ELECTRICAL CHARACTERISTICS

(Refer to the test circuit, $V_s = \pm 17V$, $T_{amb} = 25°C$ unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
V_s	Supply voltage		± 5		± 22	V
I_d	Quiescent drain current	$V_s = \pm 22$ V		60		mA
I_b	Input bias current			0.15		μA
V_{os}	Input offset voltage			5		mV
I_{os}	Input offset current			0.05		μA
V_{os}	Output offset voltage			10	100	mV
P_o	Output power	d = 1% $G_v = 30$ dB $T_{case} \leq 70°C$ f = 40 to 15 000 Hz $V_s = \pm 17V$ $R_L = 4\ \Omega$ $V_s = \pm 18V$ $R_L = 4\ \Omega$ $V_s = \pm 18V$ $R_L = 8\ \Omega$	 15	 18.5 20 16.5		 W W W
		d = 10% $G_v = 30$ dB $T_{case} \leq 70°C$ f = 1 kHz $V_s = \pm 17V$ $R_L = 4\ \Omega$ $V_s = \pm 18V$ $R_L = 8\ \Omega$		 24 20		 W W
V_i	Input sensitivity	$G_v = 30$ dB f = 1 kHz $P_o = 15$ W $V_s = \pm 17V$ $R_L = 4\ \Omega$ $V_s = \pm 18V$ $R_L = 8\ \Omega$		 260 380		 mV mV
B	Frequency response (-3 dB)	$R_L = 4\ \Omega$ C4 = 68 pF		10 to 160 000		Hz
d	Distortion	P_o = 150 mW to 15W $R_L = 4\ \Omega$ $G_v = 30$ dB $T_{case} \leq 70°C$ f = 1 kHz f = 40 to 15 000 Hz		 0.2 0.3	 1	 % %
		P_o = 150 mW to 15W $V_s = \pm 18V$ $R_L = 8\ \Omega$ $G_v = 30$ dB $T_{case} \leq 70°C$ f = 1 kHz f = 40 to 15 000 Hz		 0.1 0.25		 % %
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

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
e_N	Input noise voltage	$R_L = 4\ \Omega$		4		μV
i_N	Input noise current	B(−3 dB) = 10 to 20,000 Hz		0.1		nA
SVR	Supply voltage rejection	$R_L = 4\ \Omega$ $G_v = 30$ dB $f_{ripple} = 100$ Hz		50		dB
I_d	Drain current	$P_o = 18.5$W $R_L = 4\ \Omega$		1		A
		$P_o = 16.5$W $V_s = \pm 18$V $R_L = 8\ \Omega$		0.7		A
T_{sd}	Thermal shut-down junction temperature			140		°C
T_{sd}	Thermal shut-down case temperature	$P_{tot} = 15.5$W		105		°C

Fig. 1 - Output power vs. supply voltage

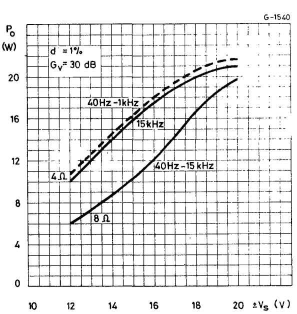


Fig. 2 - Output power vs. supply voltage

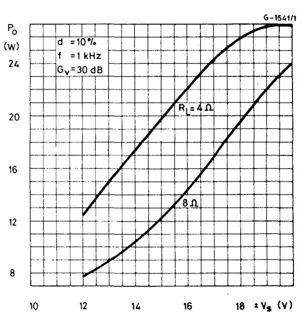


Fig. 3 - Distortion vs. output power

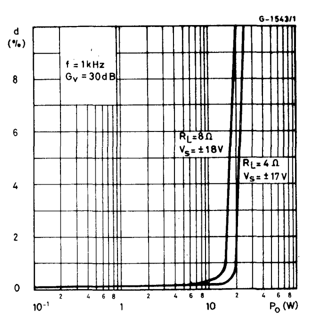


Fig. 4 - Distortion vs. output power ($R_L = 4\ \Omega$)

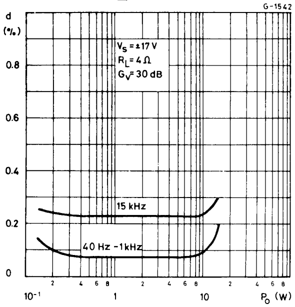


Fig. 5 - Distortion vs. output power ($R_L = 8\ \Omega$)

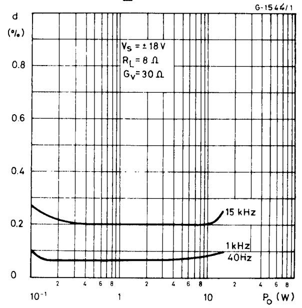


Fig. 6 - Distortion vs. frequency

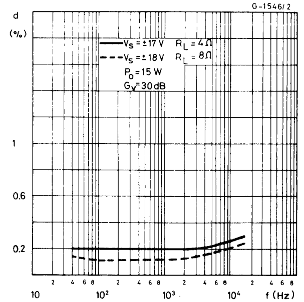


Fig. 7 - Output power vs. frequency

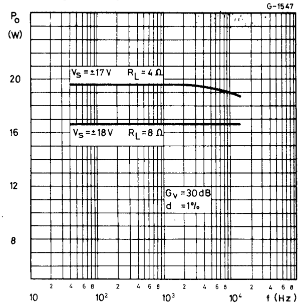


Fig. 8 - Sensitivity vs. output power ($R_L = 4\ \Omega$)

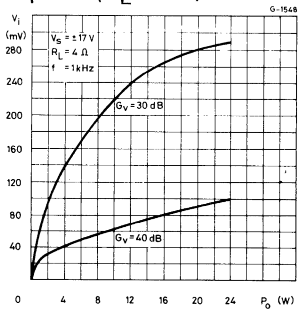


Fig. 9 - Sensitivity vs. output power ($R_L = 8\ \Omega$)

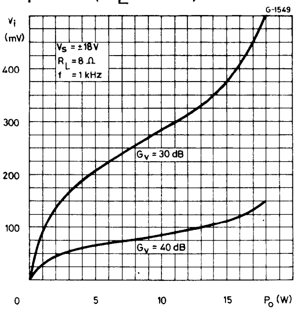


Fig. 10 - Open loop frequency response with different values of the rolloff capacitor C4

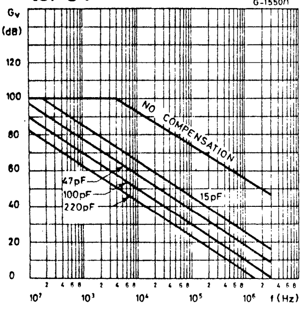


Fig. 11 - Value of C4 vs. voltage gain for different bandwidths

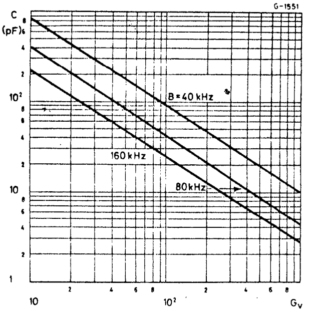


Fig. 12 - Quiescent current vs. supply voltage

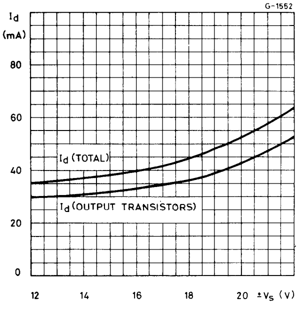


Fig. 13 - Supply voltage rejection vs. voltage gain

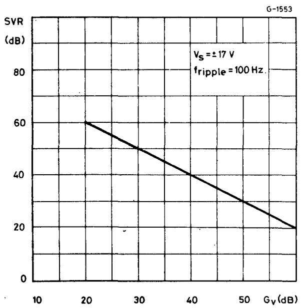


Fig. 14 - Power dissipation and efficiency vs. output power

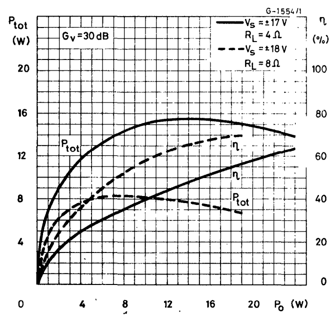
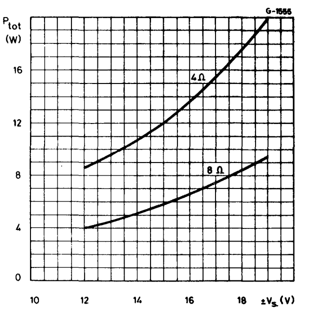
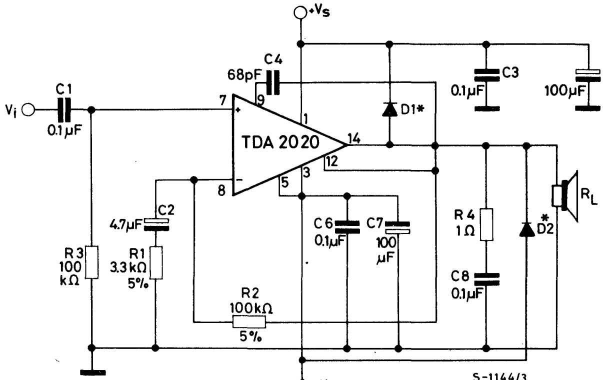


Fig. 15 - Maximum power dissipation vs. supply voltage (sine wave operation)



APPLICATION INFORMATION

Fig. 16 - Application circuit with split power supply



*1N4001 OR EQUIVALENT

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

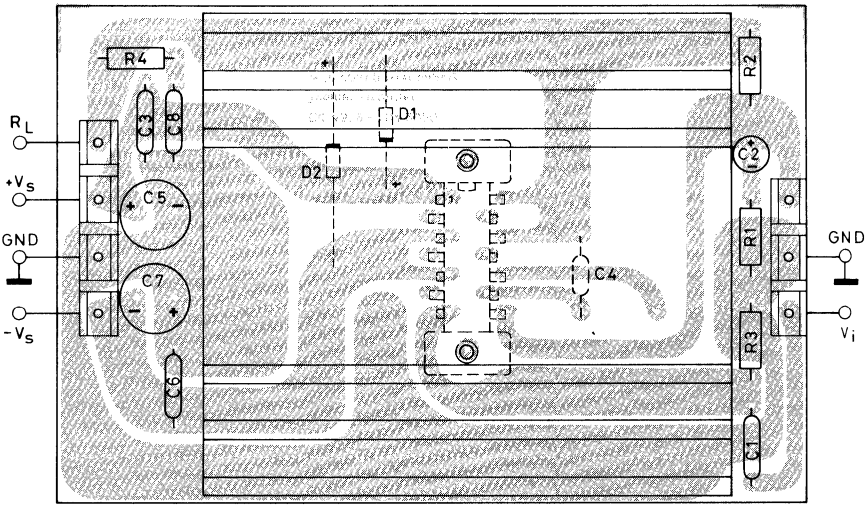


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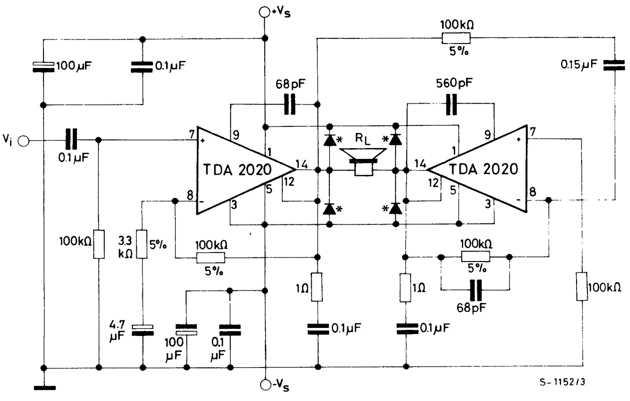
Fig. 18 - 30W bridge amplifier configuration with split power supply ($R_L = 8\ \Omega$ d ≤ 1% ; $V_s = \pm 17V$)



*1N4001 OR EQUIVALENT

SHORT CIRCUIT PROTECTION

The most important innovation in the TDA 2020 is an original circuit which limits the current of the output transistors. Fig. 19 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. 20). This function can therefore be considered as being peak power limiting rather than simple current limiting. The TDA 2020 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. 19 - Maximum output current vs. voltage (V_{CE}) across each output transistor

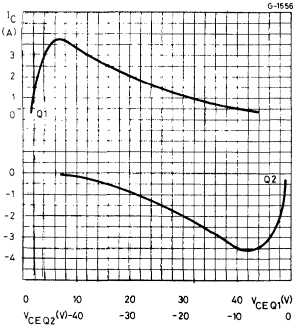
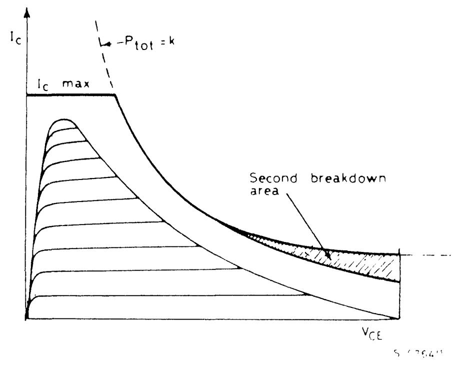


Fig. 20 - Safe operating area and collector characteristics of the protected power transistor



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. 21 - Output power and drain current vs. case temperature ($R_L = 8\ \Omega$)

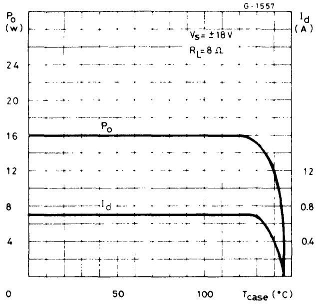


Fig. 22 - Output power and drain current vs. case temperature ($R_L = 4\ \Omega$)

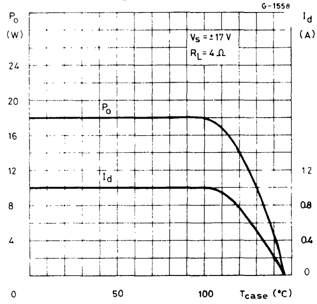
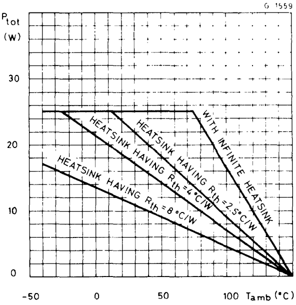


Fig. 23 - Maximum allowable power dissipation vs. ambient temperature



MOUNTING INSTRUCTIONS

The power dissipated in the circuit must be removed by adding an external heatsink as shown in figs. 24 and 25.
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. 24 - Mounting system of TDA 2020

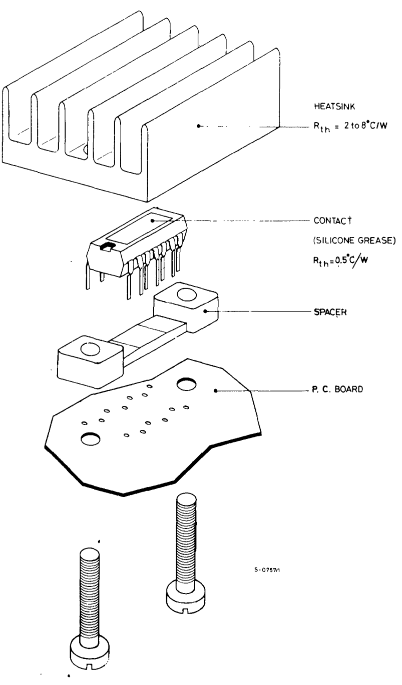


Fig. 25 - Cross-section of mounting system