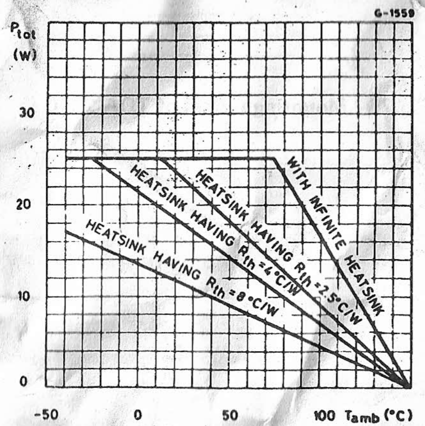
The maximum allowable power dissipation depends upon the size of the external heatsink (i. e. its thermal resistance); fig. 28 shows this dissipable power as a function of ambient temperature for different thermal resistance.

Fig. 28 - Maximum allowable power dissipation vs. ambient temperature



For a more detailed description of the TDA 2020 and related performance refer to SGS-ATES Application Note n. 130.

LINEAR INTEGRATED CIRCUIT TDA 2020

PRELIMINARY DATA

20 W Hi-Fi AUDIO POWER AMPLIFIER WITH SHORT CIRCUIT PROTECTION AND THERMAL SHUT-DOWN

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 20 W output power (d = 1%) at ± 18 V/4 Ω; the guaranteed output power at ± 17 V/4 Ω is 15 W (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 the working point of the output transistors within their safe operating area. A conventional thermal shut-down system is also included. The TDA 2020 is pin to pin equivalent to TDA 2010.

*(or, optionally, dual in-line)

ABSOLUTE MAXIMUM RATINGS

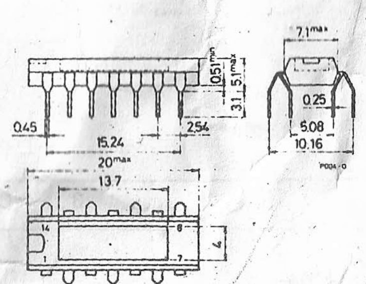
V_s	Supply voltage	± 22	V
V_i	Input voltage	V_s	
V_i	Differential input voltage	± 15	V
I_o	Output peak current (internally limited)	3.5	A
P_{tot}	Power dissipation at $T_{case} \leq 75$ °C	25	W
T_{stg}, T_j	Storage and junction temperature	-40 to 150	°C

ORDERING NUMBERS:

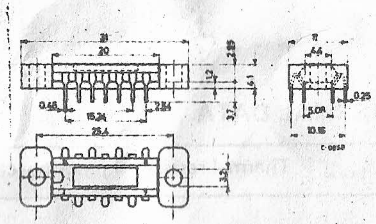
TDA 2020 A82	dual in-line plastic package
TDA 2020 A92	quad in-line plastic package
TDA 2020 AC2	dual in-line plastic package with spacer
TDA 2020 AD2	quad in-line plastic package with spacer

MECHANICAL DATA

Dimensions in mm

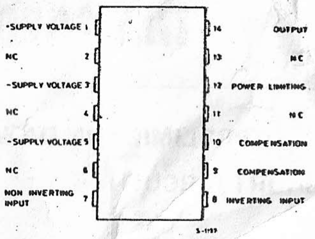


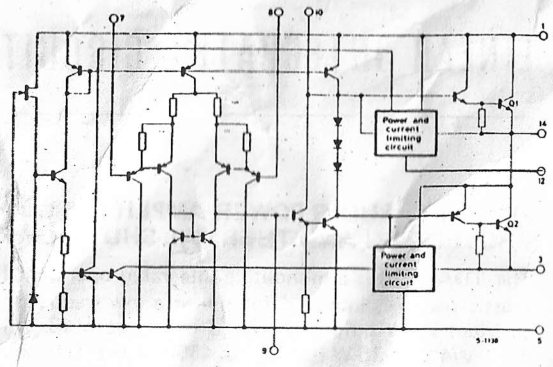
TDA 2020 A92



TDA 2020 AD2

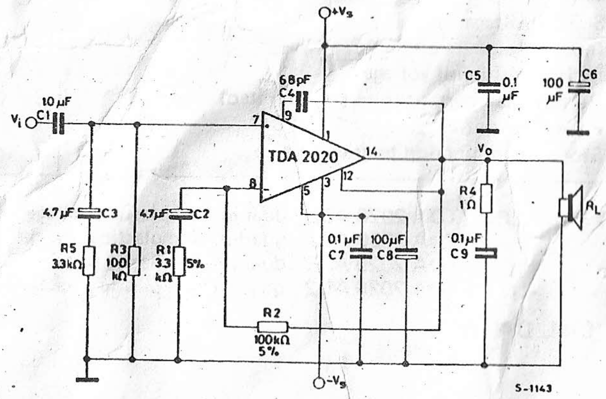
CONNECTION AND SCHEMATIC DIAGRAMS





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

TEST CIRCUIT



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	$V_s = \pm 22V$		60		mA
I_b	Bias current	$V_s = \pm 17V$		0.15		μA
$V_{i(off)}$	Input offset voltage	$V_s = \pm 17V$		5		mV
$I_{i(off)}$	Input offset current	$V_s = \pm 17V$		0.05		μA
$V_{o(off)}$	Output offset voltage	$V_s = \pm 17V$		10	100	mV
P_o	Output power	d = 1% $G_v = 30$ dB $T_{case} \leq 70$ °C f = 40 to 15,000 Hz				
		$V_s = \pm 17V$ $R_L = 4\ \Omega$	15	18.5		W
		$V_s = \pm 18V$ $R_L = 4\ \Omega$		20		W
		$V_s = \pm 18V$ $R_L = 8\ \Omega$		16.5		W
		d = 10% $G_v = 30$ dB $T_{case} \leq 70$ °C f = 1 kHz				
		$V_s = \pm 17V$ $R_L = 4\ \Omega$		24		W
		$V_s = \pm 18V$ $R_L = 8\ \Omega$		20		W
V_i	Input sensitivity	$G_v = 30$ dB f = 1 kHz $P_o = 15W$				
		$V_s = \pm 17V$ $R_L = 4\ \Omega$		260		mV
		$V_s = \pm 18V$ $R_L = 8\ \Omega$		380		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		0.2		%
		f = 40 to 15,000 Hz		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		0.1		%
		f = 40 to 15,000 Hz		0.25		%

ELECTRICAL CHARACTERISTICS (continued)

	Parameter	Test conditions		Min.	Typ.	Max.	Unit
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)			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) = 10 to 20,000 Hz			0.1		nA
SVR	Supply voltage rejection ratio	$R_L = 4\Omega$ $f_{ripple} = 100$ Hz	$G_v = 30$ dB		50		dB
I_d	Drain current	$P_o = 18.5W$	$R_L = 4\ \Omega$		1		A
		$P_o = 16.5W$ $R_L = 8\ \Omega$	$V_s = \pm 18V$		0.7		A
	Thermal shut-down junction temperature				145		°C
	* Thermal shut-down case temperature	$P_{tot} = 15.5W$			105		°C

* See fig. 15

Fig. 1 - Typical output power vs. supply voltage (d = 1%)

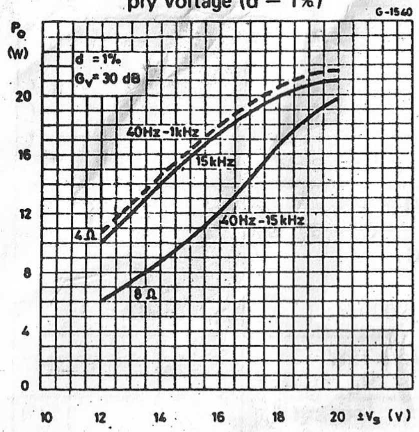


Fig. 2 - Typical output power vs. supply voltage (d = 10%)

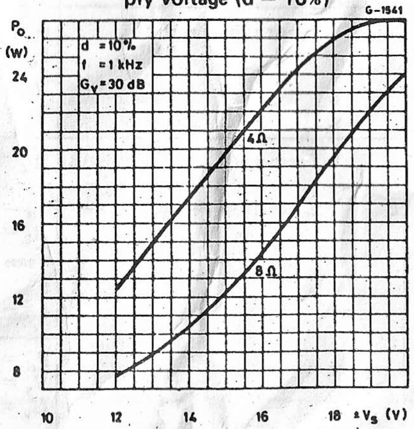


Fig. 3 - Typical distortion vs. output power ($R_L = 4\ \Omega$)

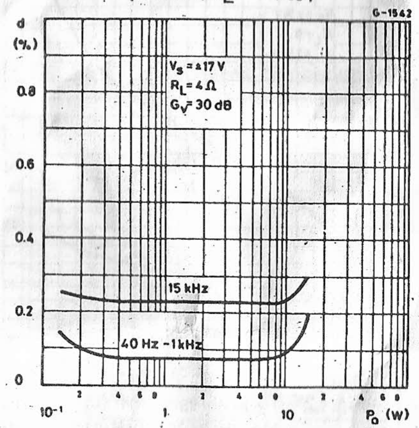


Fig. 4 - Typical distortion vs. output power ($R_L = 4\Omega$)

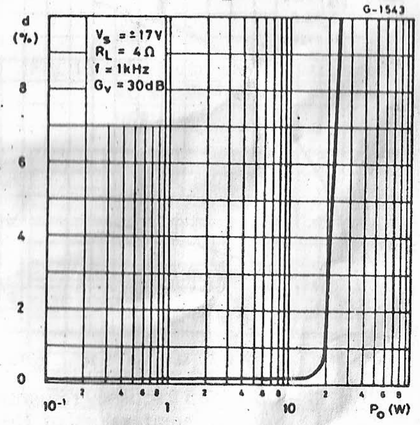


Fig. 5 - Typical distortion vs. output power ($R_L = 8\ \Omega$)

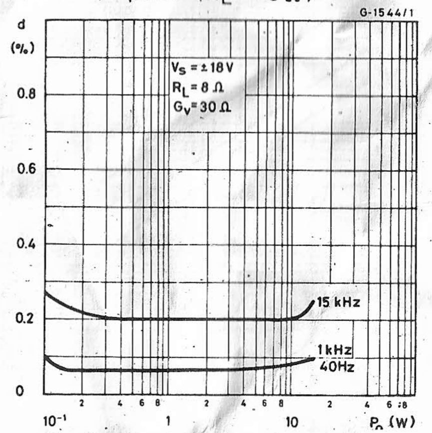


Fig. 6 - Typical distortion vs. output power ($R_L = 8\ \Omega$)

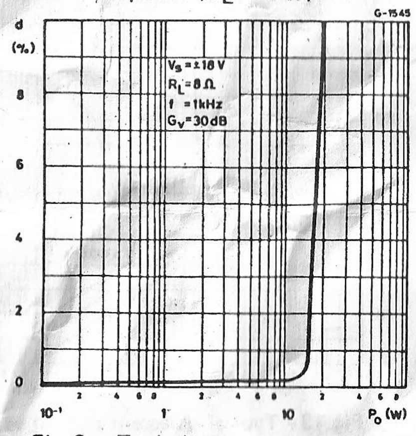


Fig. 7 - Typical distortion vs. frequency

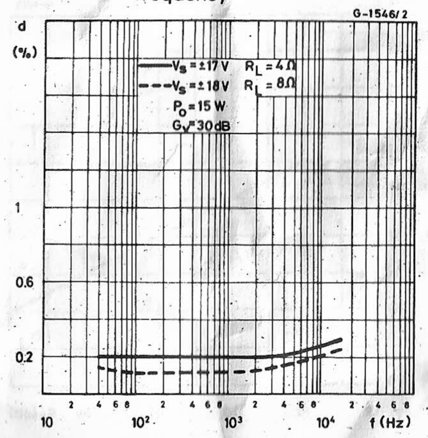


Fig. 8 - Typical output power vs. frequency

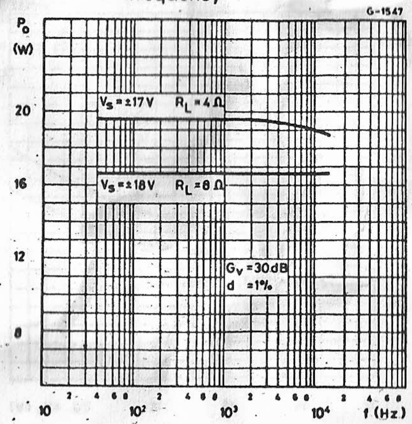


Fig. 9 - Typical sensitivity vs. output power ($R_L = 4\,\Omega$)

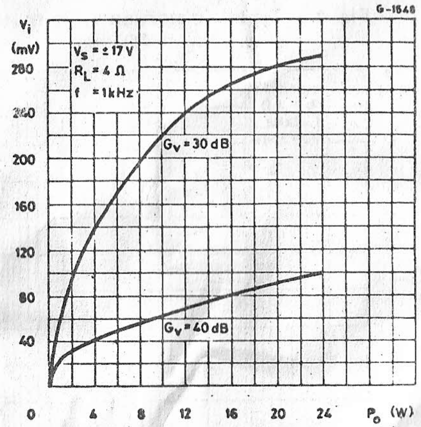


Fig. 10 - Typical sensitivity vs. output power ($R_L = 8\,\Omega$)

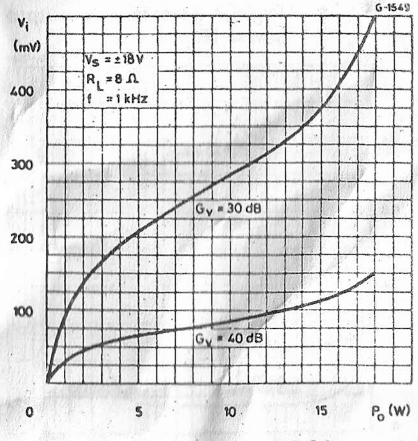


Fig. 11 - Open loop frequency response with different values of the rolloff capacitor C4

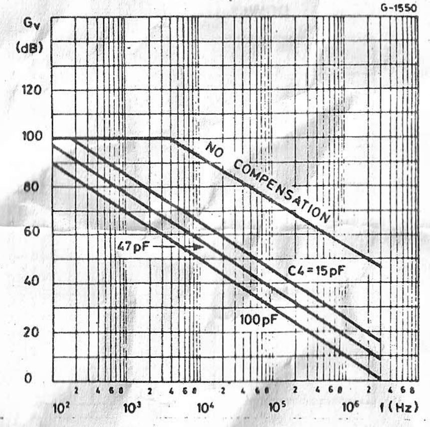


Fig. 12 - Typical value of C4 vs. voltage gain for different bandwidths

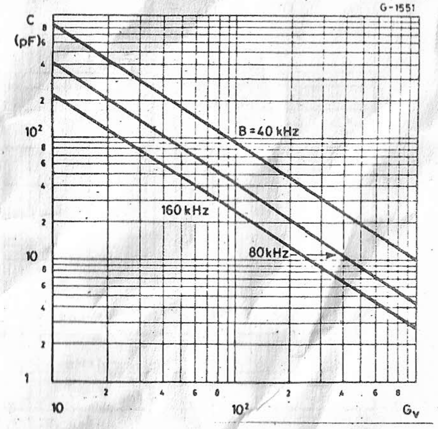


Fig. 13 - Typical quiescent current vs. supply voltage

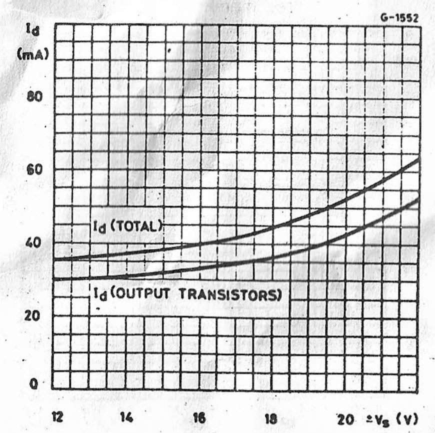


Fig. 14 - Typical supply voltage rejection ratio vs. voltage gain

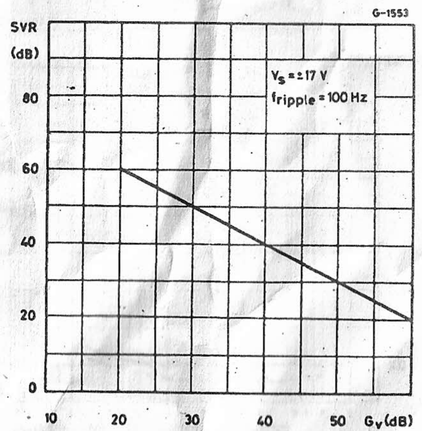


Fig. 15 - Typical power dissipation and efficiency vs. output power

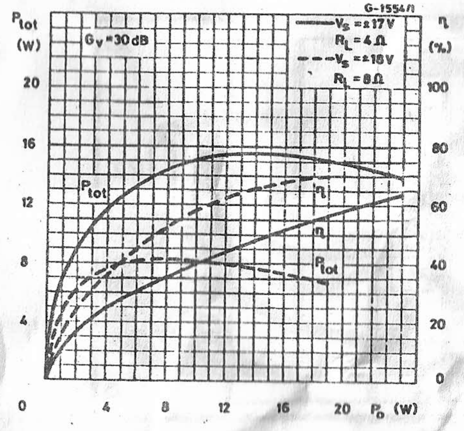
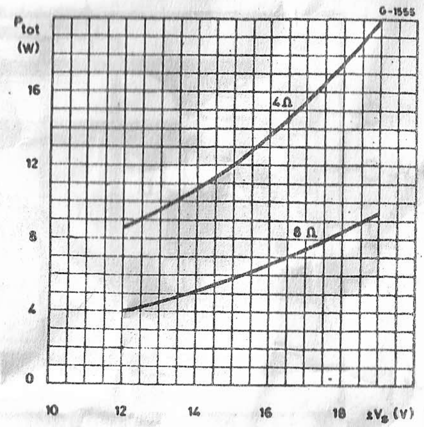


Fig. 16 - Maximum power dissipation vs. supply voltage (sine wave operation)



APPLICATION INFORMATION

Fig. 17 - Typical amplifier with split power supply

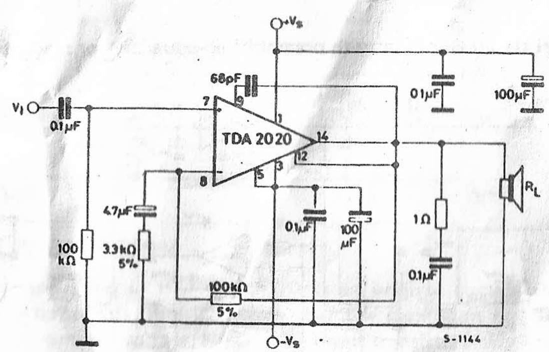
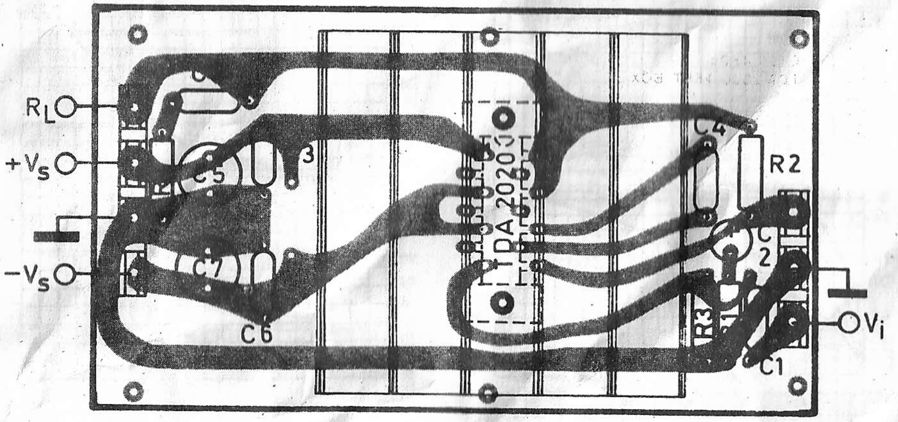


Fig. 18 - P.C. board and component layout for the circuit of fig. 17 (1:1 scale)



CS-0065

Fig. 19 - 15 W Hi-Fi stereo amplifier with preamplifier-equalizer for magnetic pick-ups

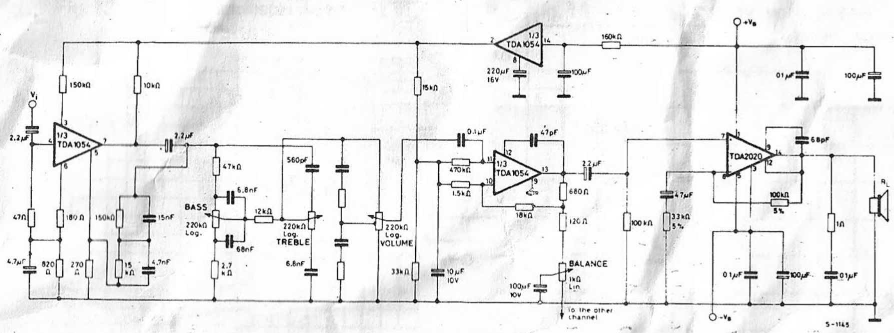


Fig. 20 - Typical stereo amplifier with split power supply

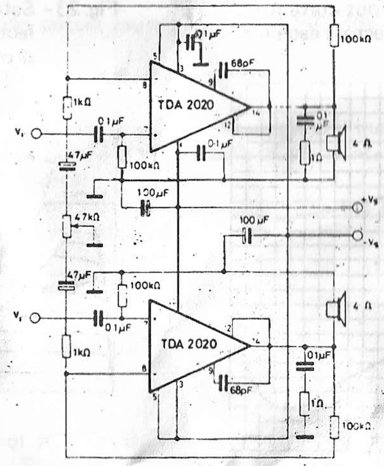
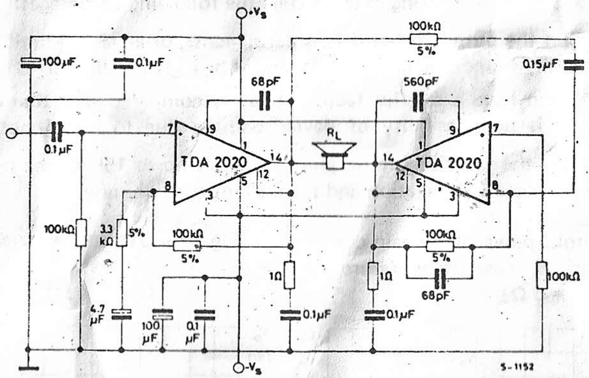


Fig. 21 - Typical bridge amplifier configuration with split power supply ($R_L = 8\,\Omega$ d ≤ 1%: $P_o = 20$ W @ $V_s = \pm 14$ V and $P_o = 30$ W @ $V_s = \pm 17$V)



SHORT CIRCUIT PROTECTION

The most important innovation in the TDA 2020 is an original circuit which limits the current of the output transistors. Fig. 22 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. 23). 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. 22 - Maximum output current vs. voltage (V_{CE}) across each output transistor

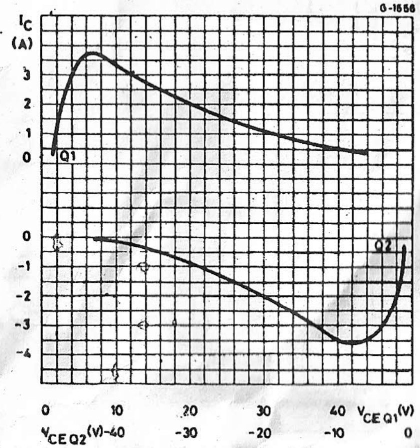
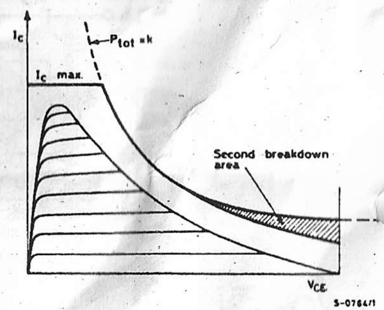


Fig. 23 - Safe operating area and collector characteristics of the protected power transistor



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

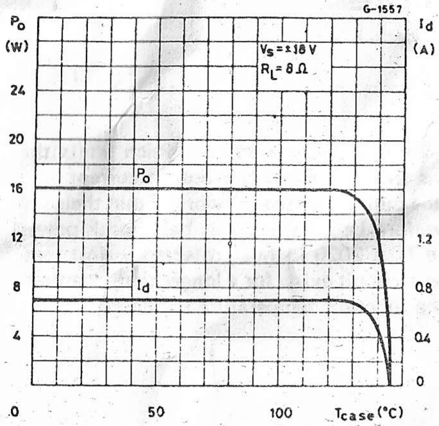
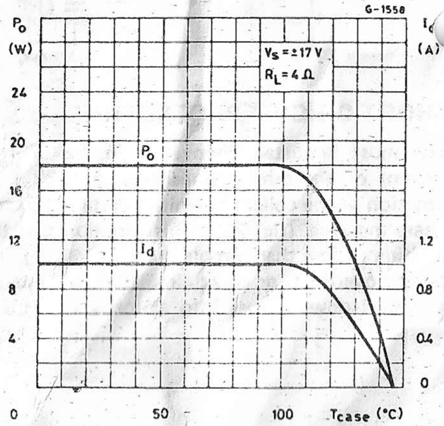


Fig. 25 - Output power and drain current vs. case temperature ($R_L = 4\ \Omega$)



MOUNTING INSTRUCTIONS

The power dissipated in the circuit must be removed by adding an external heatsink as shown in figs. 26 and 27.

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. 26 - Mounting system of TDA 2020

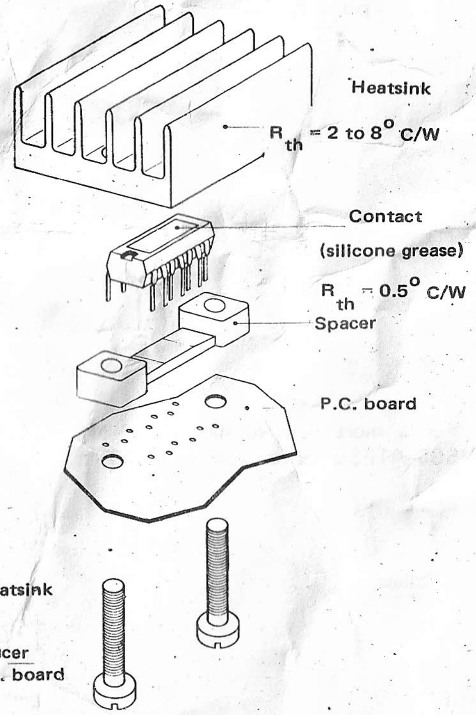


Fig. 27 - Cross-section of mounting system