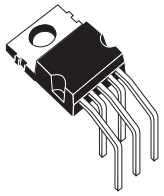
TDA2030

14 W hi-fi audio amplifier

Features

- Wide-range supply voltage, up to 36 V
- Single or split power supply
- Short-circuit protection to ground
- Thermal shutdown



Pentawatt (horizontal)

Description

The TDA2030 is a monolithic integrated circuit in the Pentawatt® package, intended for use as a low frequency class-AB amplifier. Typically it provides 14 W output power (d = 0.5%) at 14 V/4 Ω. At ±14 V or 28 V, the guaranteed output power is 12 W on a 4 Ω load and 8 W on an 8 Ω (DIN45500).

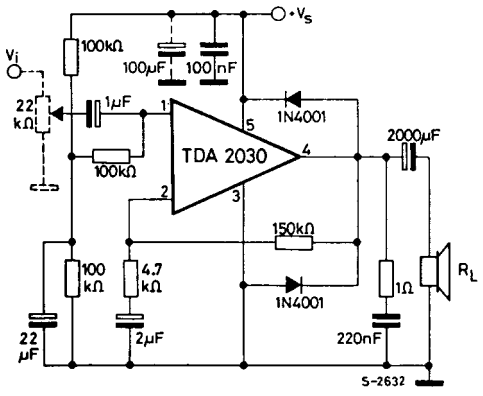
The TDA2030 provides high output current and has very low harmonic and crossover distortion.

Furthermore, 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 operating point of the output transistors within their safe operating range. A conventional thermal shutdown system is also included.

Table 1. Device summary

Order code	Package
TDA2030H	Pentawatt horizontal

Figure 1. Ex: Functional block diagram



1 Device overview

Figure 2. Pin connections (top view)

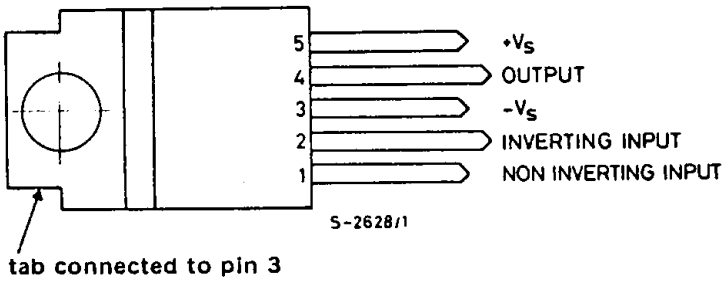
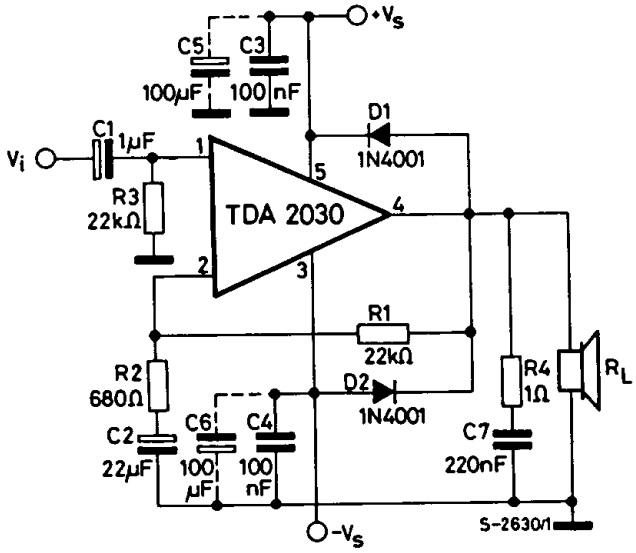


Figure 3. Test circuit



2 Electrical specifications

2.1 Absolute maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_s	Supply voltage	±18 (36)	V
V_i	Input voltage	Vs	
V_i	Differential input voltage	±15	V
I_o	Output peak current internally limited)	3.5	A
P_{tot}	Power dissipation at T_{case} = 90 °C	20	W
T_{stg}, T_j	Storage and junction temperature	-40 to 150	°C

2.2 Thermal data

Table 3. Thermal data

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

2.3 Electrical characteristics

Refer to the test circuit in *Figure 3*; V_S = ±14 V, T_{amb} = 25°C unless otherwise specified.

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_s	Supply voltage		± 6 12		± 18 36	V
I_d	Quiescent drain current	V_s = ± 18 (Vs = 36)		40	60	mA
I_b	Input bias current			0.2	2	µA
V_{OS}	Input offset voltage			± 2	± 20	mV
I_{OS}	Input offset current			± 20	± 200	nA
P_o	Output power	d = 0.5%, f = 40 to 15,000 Hz; G_V = 30 dB R_L = 4 Ω R_L = 8 Ω	 12 8	 14 9		 W W
		d = 10%, f =1 kHz; G_V = 30 dB R_L = 4 Ω R_L = 8 Ω	 12 8	 14 9		 W W

Table 4. Electrical characteristics (continued)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
d	Distortion	P_o = 0.1 to 12 W, R_L = 4 Ω, G_V = 30 dB f = 40 to 15.000 Hz		0.2	0.5	%
		P_o = 0.1 to 8 W, R_L = 8 Ω, G_V = 30 dB f = 40 to 15.000 Hz		0.1	0.5	%
B	Frequency response (–3 dB)	P_o = 12 W, R_L = 4 Ω; G_V = 30 dB	10 Hz to 140			Hz
R_i	Input resistance (pin 1)		0.5	5		MΩ
G_V	Voltage gain (open loop)			90		dB
G_V	Voltage gain (closed loop)	f = 1 kHz	29.5	30	30.5	dB
e_N	Input noise voltage	B = 22 Hz to 22 kHz		3	10	µV
i_N	Input noise current			80	200	pA
SVR	Supply voltage rejection	G_V = 30 dB; R_L = 4 Ω, R_g = 22 kΩ, f_{ripple} = 100 Hz; V_{ripple} = 0.5 Veff	40	50		dB
I_d	Drain current	P_o = 14 W, R_L = 4 Ω P_o = 9 W, R_L = 8 Ω		900 500		mA
T_j	Thermal shutdown junction temperature				145	°C

2.4 Characterizations

Figure 4. Output power vs. supply voltage

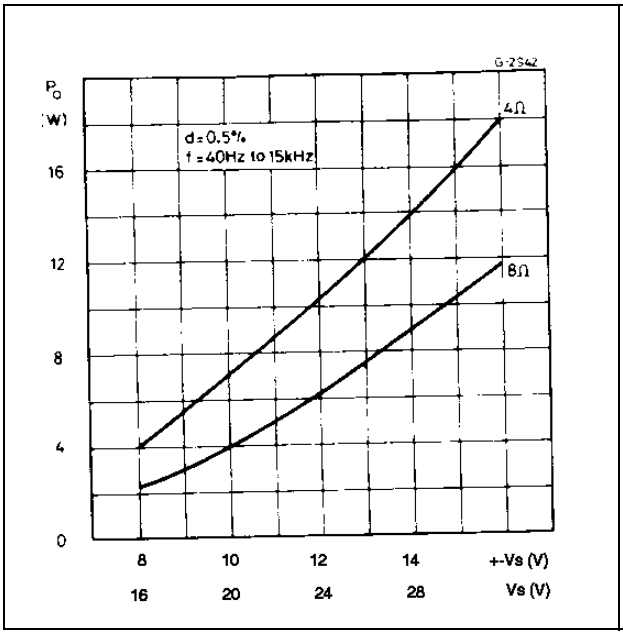


Figure 5. Output power vs. supply voltage

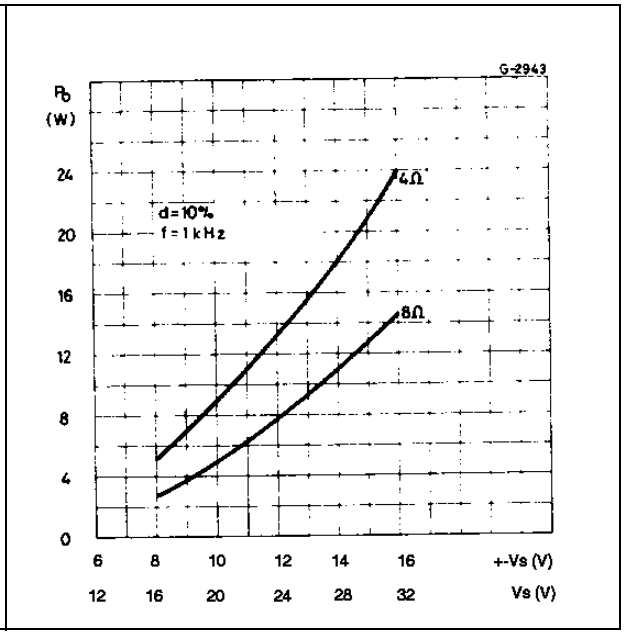


Figure 6. Distortion vs. output power

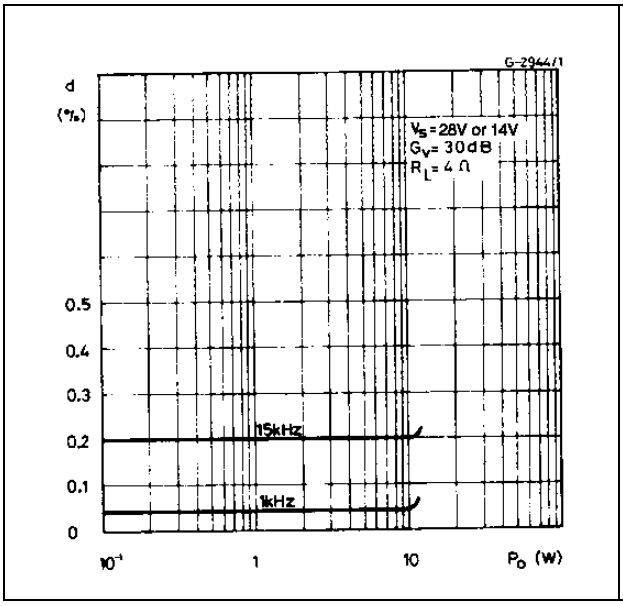


Figure 7. Distortion vs. output power

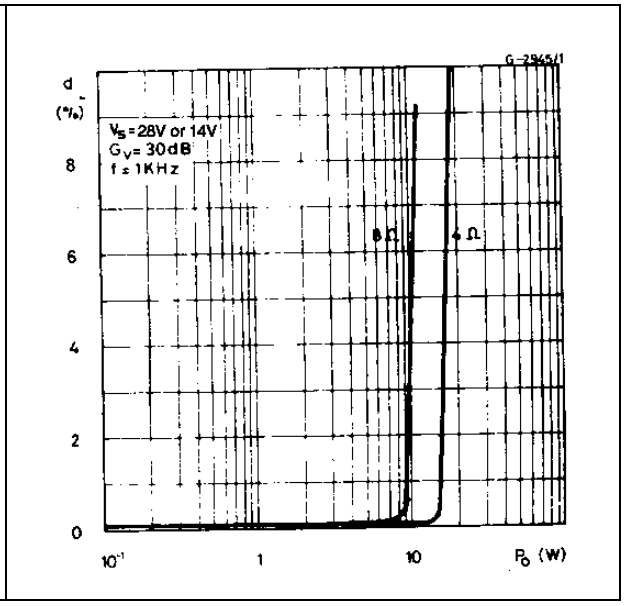


Figure 8. Distortion vs. output power

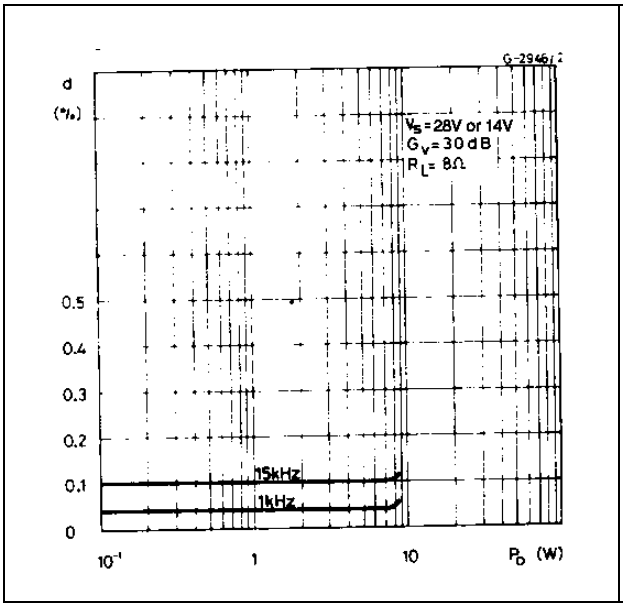


Figure 9. Distortion vs. frequency

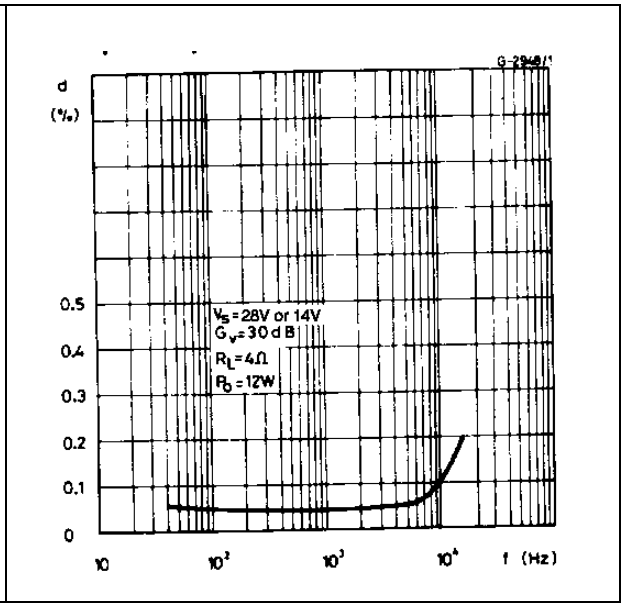


Figure 10. Distortion vs. frequency

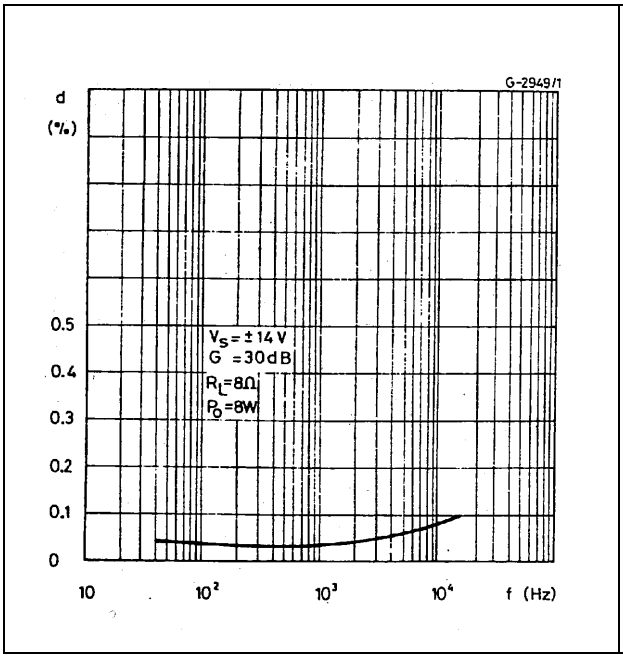


Figure 11. Frequency response with different values of the rolloff capacitor C8 (see typical amplifier with split power supply)

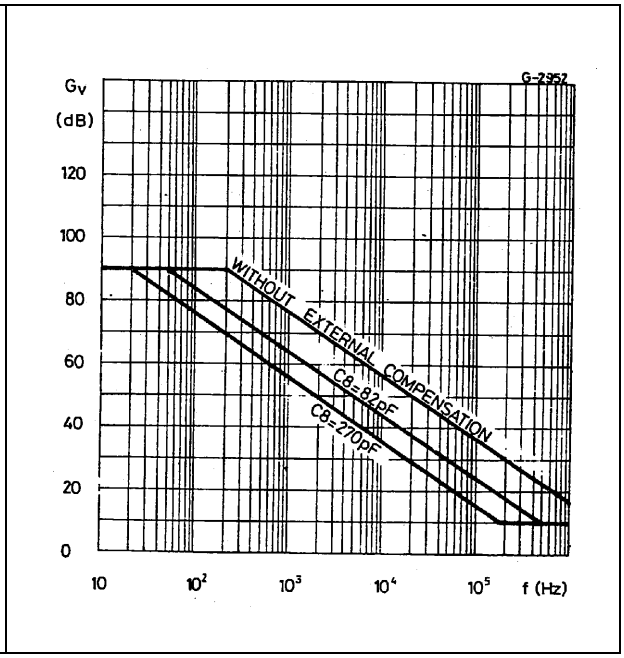


Figure 12. Quiescent current vs. supply voltage

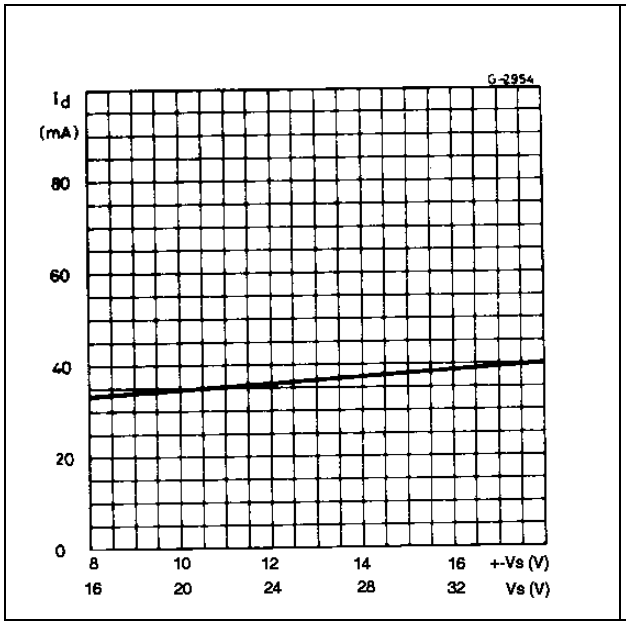


Figure 13. Supply voltage rejection vs. voltage gain

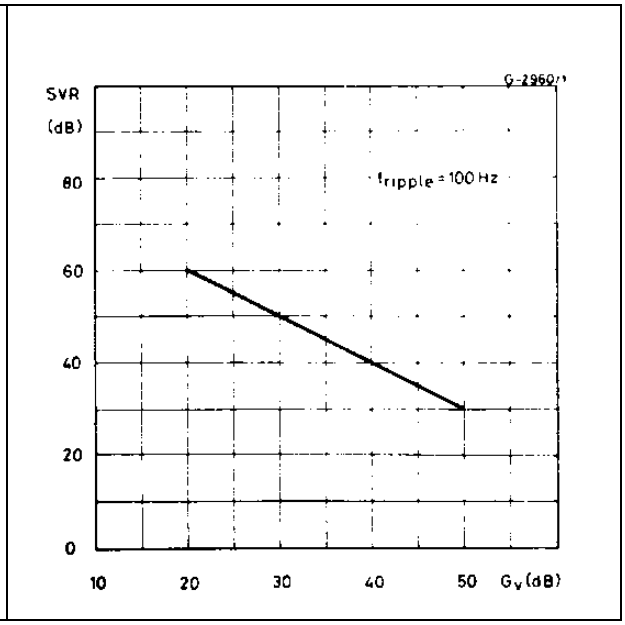


Figure 14. Power dissipation and efficiency vs. output power

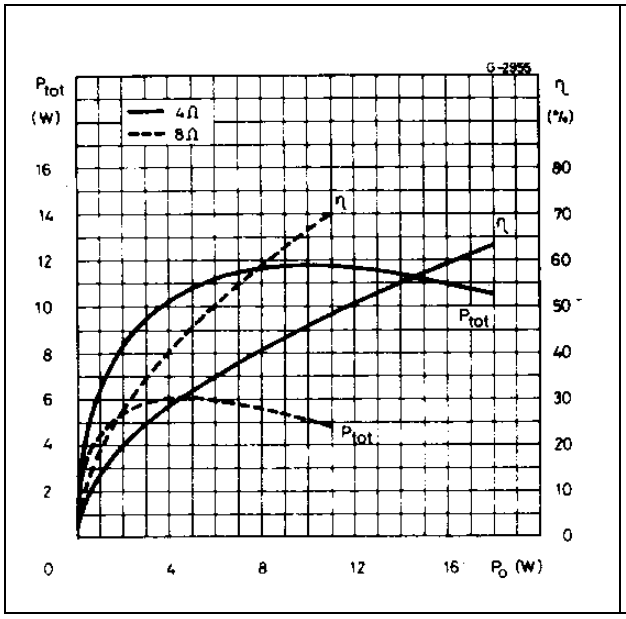
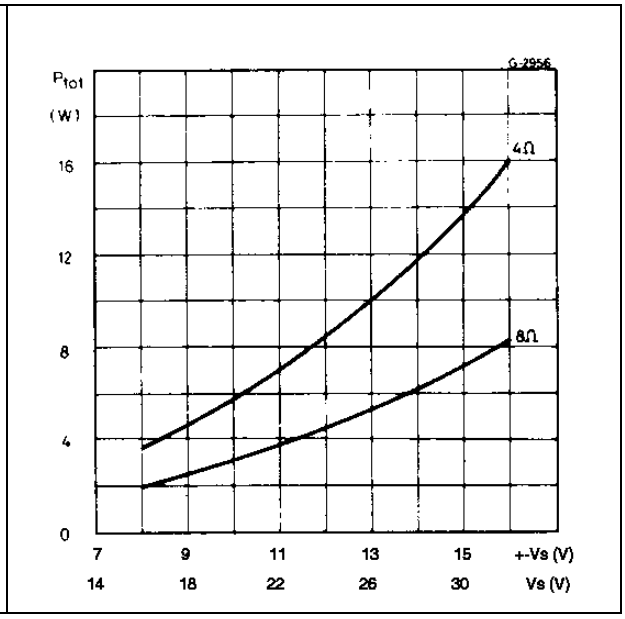


Figure 15. Maximum power dissipation vs. supply voltage (sine wave operation)



3 Applications

Figure 16. Typical amplifier with split power supply

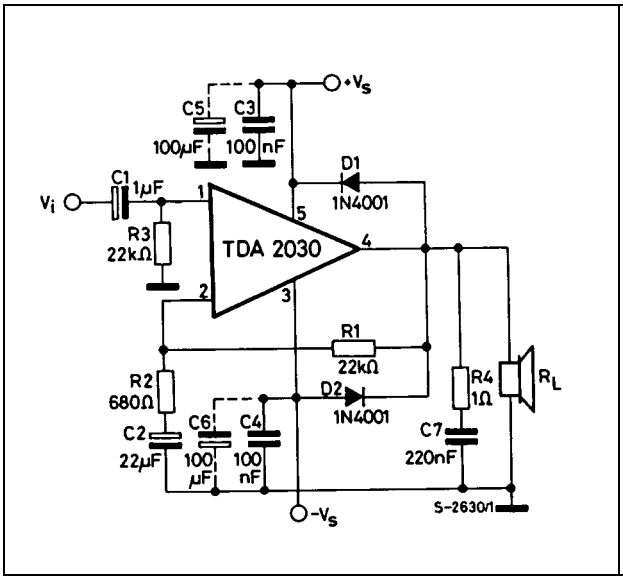


Figure 17. Typical amplifier with single power supply

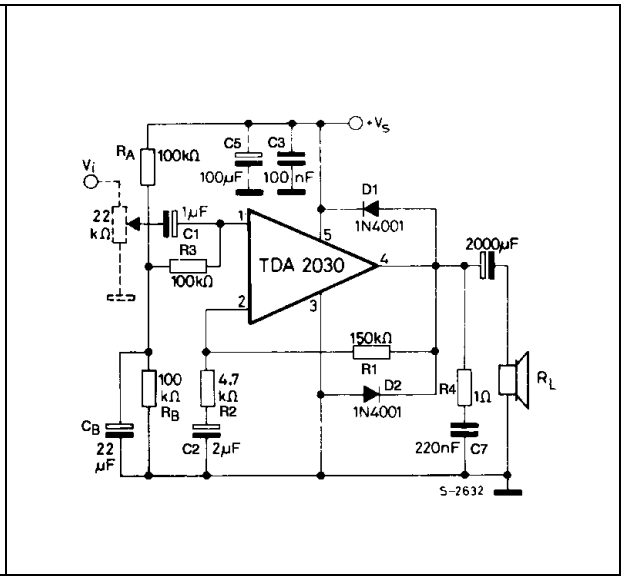


Figure 18. PC board and component layout for a typical amplifier with split power supply

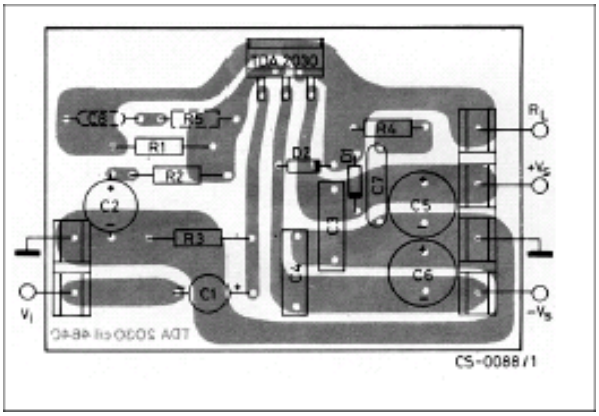


Figure 19. PC board and component layout for a typical amplifier with single power supply

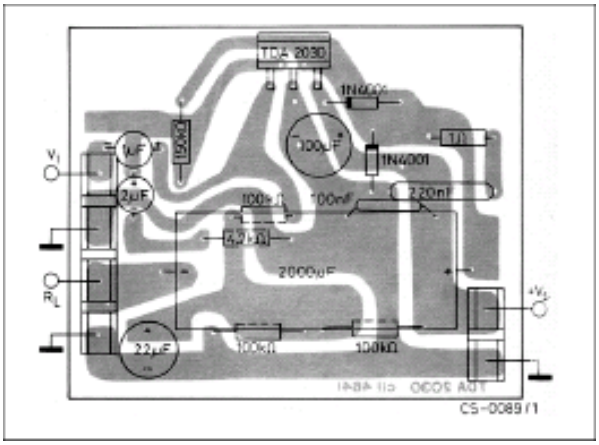
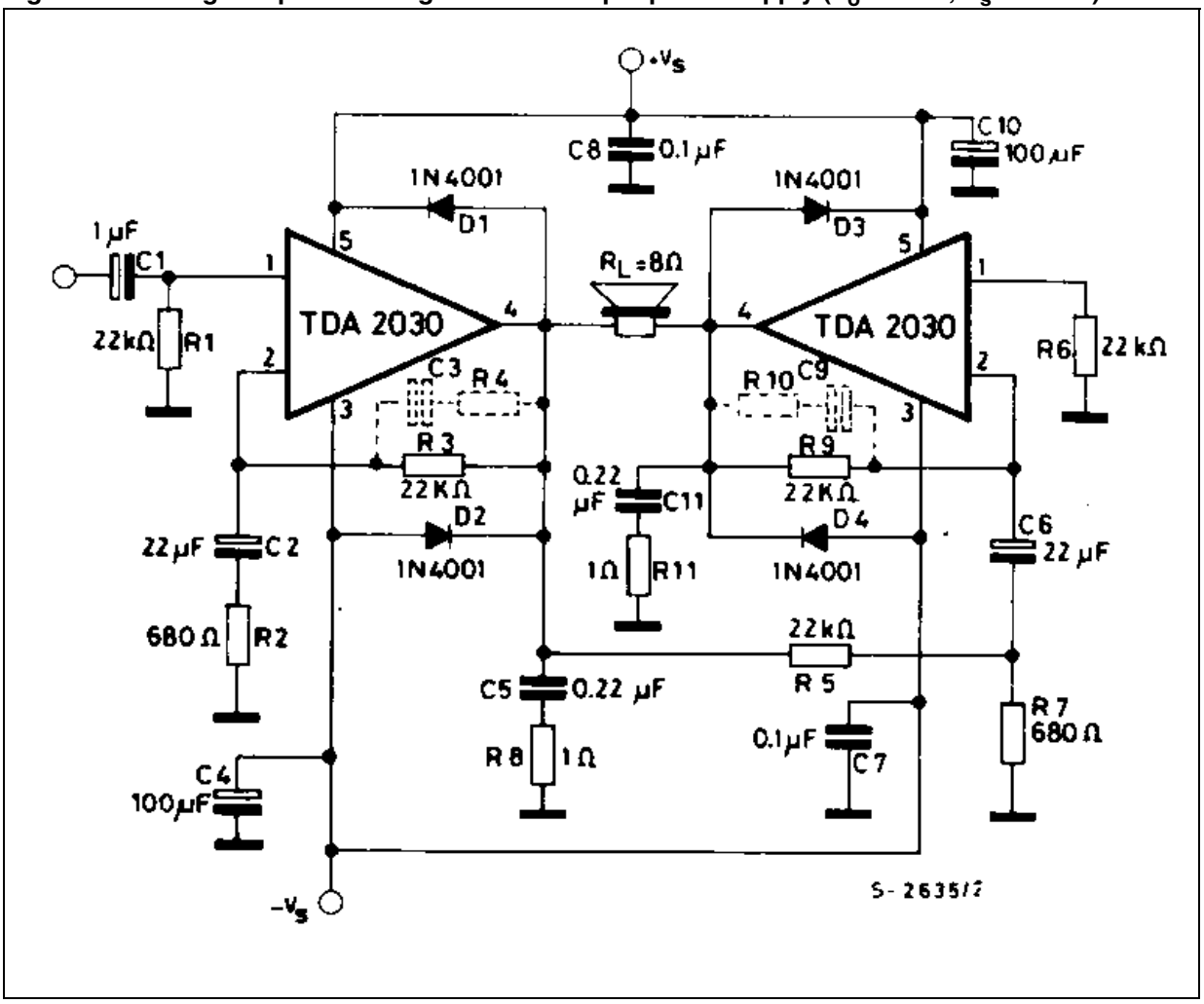


Figure 20. Bridge amplifier configuration with split power supply (P_o = 28 W, V_s = ±14 V)



4 Practical considerations

4.1 Printed circuit board

The layout shown in *Figure 19* should be adopted by the designers. If different layouts are used, the ground points of input 1 and input 2 must be well decoupled from the ground return of the output in which a high current flows.

4.2 Assembly suggestion

No electrical isolation is needed between the package and the heatsink with single supply voltage configuration.

4.3 Application suggestions

The recommended values of the components are those shown on application circuit of *Figure 16*. However, if different values are chosen, then the following table can be helpful.

Table 5. Variations from recommended values

Component	Recommanded value	Purpose	Larger than recommanded value	Smaller than recommanded value
R_1	22 kΩ	Closed loop gain setting	Increase of gain	Decrease in gain(1)
R_2	680 Ω	Closed loop gain setting	Decrease of gain(1)	Increase in gain
R_3	22 kΩ	Non-inverting input biasing	Increase of input impedance	Decrease in input impedance
R_4	1 Ω	Frequency stability	Danger of oscillation at high frequencies with inductive loads	
R_5	3 R_2	Upper frequency cutoff	Poor high-frequency attenuation	Danger of oscillation
C_1	1 µF	Input DC decoupling		Increase in low-frequency cutoff
C_2	22 µF	Inverting input DC decoupling		Increase in low-frequency cutoff
C_3C_4	0.1 µF	Supply voltage bypass		Danger of oscillation
C_5C_6	100 µF	Supply voltage bypass		Danger of oscillation
C_7	0.22 µF	Frequency stability		Danger of oscillation
C_8	$\frac{1}{2\pi BR_1}$	Upper frequency cutoff	Smaller bandwidth	Larger bandwidth
D_1D_2	1N4001	To protect the device against output voltage spikes		

1. Closed loop gain must be higher than 24 dB

Table 6. Single supply application

Component	Recommanded value	Purpose	Larger than recommanded value	Smaller than recommanded value
R_1	150 kΩ	Closed loop gain setting	Increase in gain	Decrease in gain(1)
R_2	4.7 kΩ	Closed loop gain setting	Decrease in gain(1)	Increase in gain
R_3	100 kΩ	Non-inverting input biasing	Increase of input impedance	Decrease in input Impedance
R_4	1 Ω	Frequency stability	Danger of oscillation at high frequencies with inductive loads	
R_A/R_B	100 kΩ	Non-inverting input biasing	Poor high-frequency attenuation	Danger of oscillation
C_1	1 µF	Input DC decoupling		Increase in low-frequency cutoff
C_2	22 µF	Inverting DC decoupling		Increase in low-frequency cutoff
C_3	0.1 µF	Supply voltage bypass		Danger of oscillation
C_5	100 µF	Supply voltage bypass		Danger of oscillation
C_7	0.22 µF	Frequency stability		Danger of oscillation
C_8	$\frac{1}{2\pi BR_1}$	Upper frequency cutoff	Smaller bandwidth	Larger bandwidth
D_1D_2	1N4001	To protect the device against output voltage spikes.		

1. Closed loop gain must be higher than 24 dB

5 Short-circuit protection

The TDA2030 has an original circuit which limits the current of the output transistors. *Figure 21* shows that the maximum output current is a function of the collector emitter voltage; hence the output transistors work within their safe operating area (*Figure 5*).

This function can therefore be considered as being peak power limiting rather than simple current limiting.

It reduces the possibility that the device gets damaged during an accidental short-circuit from AC output to ground.

Figure 21. Maximum output current vs. voltage [V_{CEsat}] across each output transistor

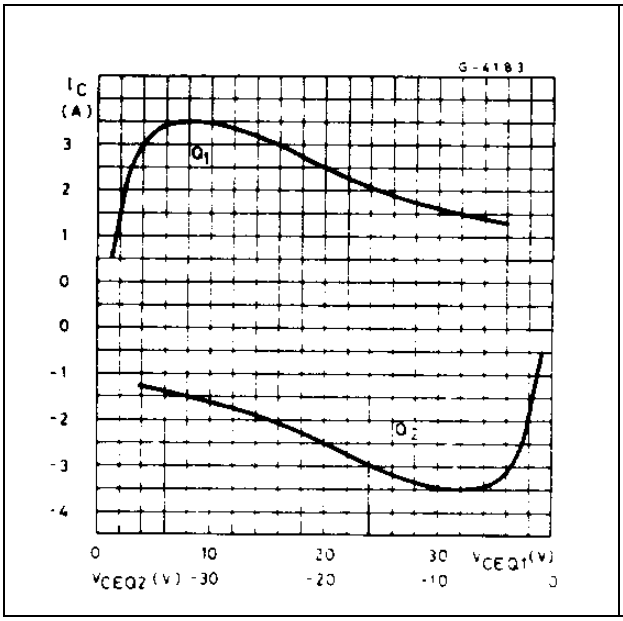
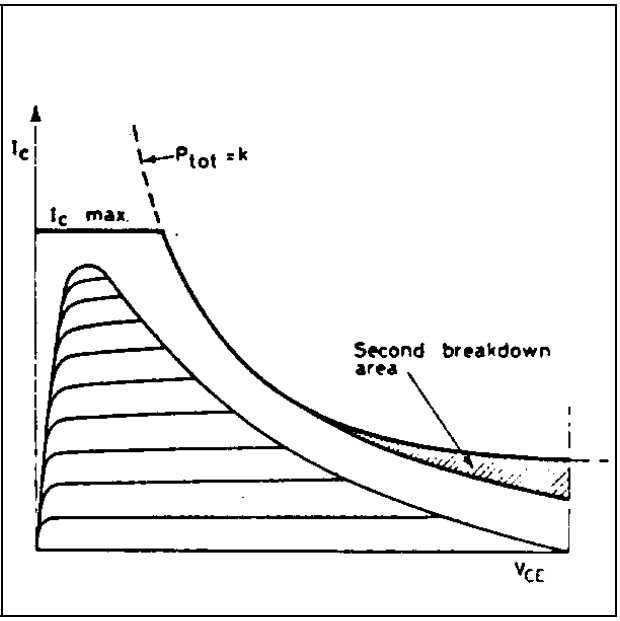


Figure 22. Safe operating area and collector characteristics of the protected power transistor



6 Thermal shutdown

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 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 to 150°C, the thermal shutdown simply reduces the power dissipation at the current consumption.

The maximum allowable power dissipation depends upon the size of the external heatsink (i.e. its thermal resistance); *Figure 25* shows this power dissipation as a function of ambient temperature for different thermal resistances.

Figure 23. Output power and drain current vs. case temperature (R_L = 4 Ω)

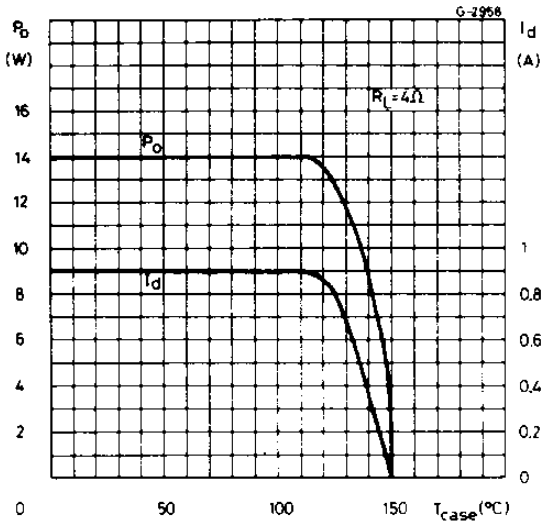


Figure 24. Output power and drain current vs. case temperature (R_L = 8 Ω)

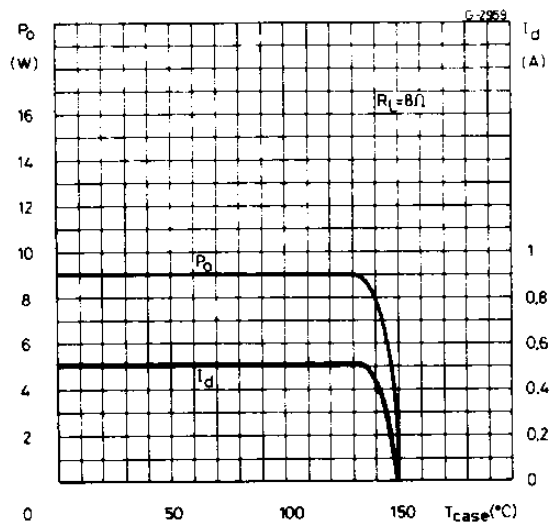


Figure 25. Maximum allowable power dissipation vs. ambient temperature

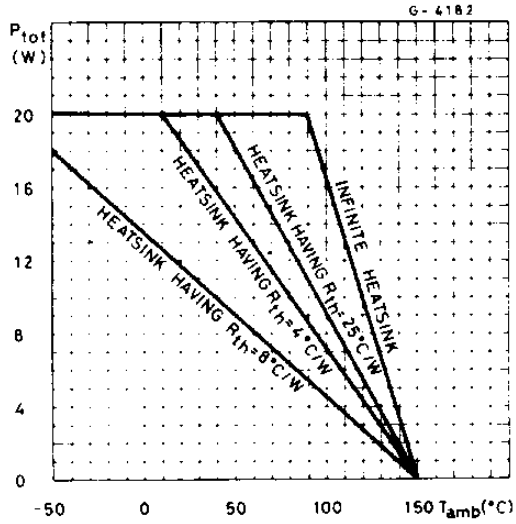
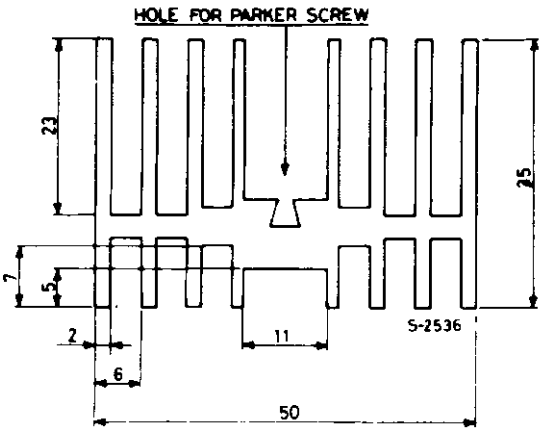


Figure 26. Example of heatsink



The following table shows the length that the heatsink in *Figure 26* must have for several values of P_{tot} and R_{th}.

Table 7. Recommended values of heatsink

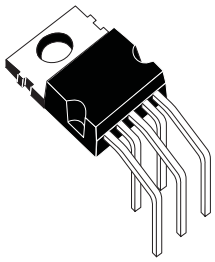
Dimension	Recommended values			Unit
P_{tot}	12	8	6	W
Length of heatsink	60	40	30	mm
R_{th} of heatsink	4.2	6.2	8.3	°C/W

7 Package mechanical data

Figure 27. Pentawatt (horizontal) package outline and dimensions

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			4.80			0.188
C			1.37			0.054
D	2.40		2.80	0.094		0.11
D1	1.20		1.35	0.047		0.053
E	0.35		0.55	0.014		0.022
F	0.80		1.05	0.031		0.041
F1	1.00		1.40	0.039		0.055
G	3.20	3.40	3.60	0.126	0.134	0.142
G1	6.60	6.80	7.00	0.260	0.267	0.275
H2			10.40			0.41
H3	10.05		10.40	0.395		0.409
L	14.20		15.00	0.56		0.59
L1	5.70		6.20	0.224		0.244
L2	14.60		15.20	0.574		0.598
L3	3.50		4.10	0.137		.161
L4			1.29			0.05
L5	2.60		3.00	0.102		0.118
L6	15.10		15.80	0.594		0.622
L7	6.00		6.60	0.236		0.260
L9	2.10		2.70	0.083		0.106
L10	4.30		4.80	0.170		0.189
DIA	3.65		3.85	0.143		0.151

OUTLINE AND MECHANICAL DATA



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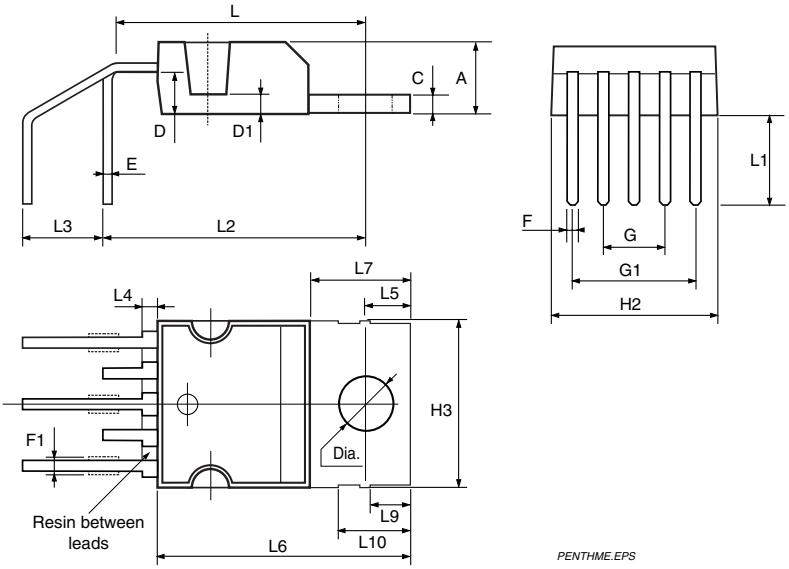

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK® is an ST trademark.

8 Revision history

Table 8. Document revision history

Date	Revision	Changes
June 1998	2	Second issue
21-Jun-2011	3	Added *Features on page 1* Removed Pentawatt (vertical) package option Replaced *Figure 27* with Pentawatt (horizontal) package data Updated presentation of document, minor textual changes