TBA800 • TBA800A ✓

5-WATT AUDIO AMPLIFIER

FAIRCHILD LINEAR INTEGRATED CIRCUIT

GENERAL DESCRIPTION – The TBA800 is a monolithic Audio Power Amplifier constructed using the Fairchild Planar* Epitaxial process. The external cooling tabs enable 2.5 W output power to be achieved without external heat sink and 5 W output power using a small area of the pc board copper as a heat sink.

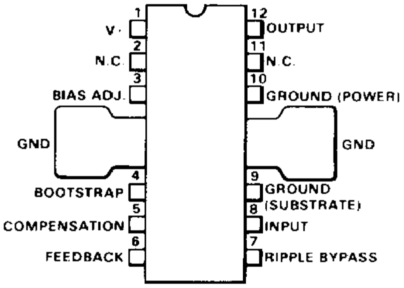
It is ideally suited as an audio amplifier in solid state television receivers and other Class B audio amplifier applications over a wide range of supply voltage (5-30 V).

- **OUTPUT POWER 5 W (24 V – 16 Ω)**
- **LOW DISTORTION**
- **WIDE SUPPLY VOLTAGE RANGE (5-30 V)**
- **HIGH PEAK OUTPUT CURRENT (1.5 A)**
- **HIGH EFFICIENCY**

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	30 V
Output Peak Current (Non-Repetitive)	2 A
Output Current (Repetitive)	1.5 A
Power Dissipation: (T_A = 80°C)	1 W
(T_{tab} = 90°C)	5 W
Storage and Junction Temperature	−40°C to +150°C
Pin Temperature (Soldering 10 s)	230°C

CONNECTION DIAGRAM
12-PIN POWER PACKAGE
(TOP VIEW)
PACKAGE OUTLINE 9W
PACKAGE CODE P3, P4

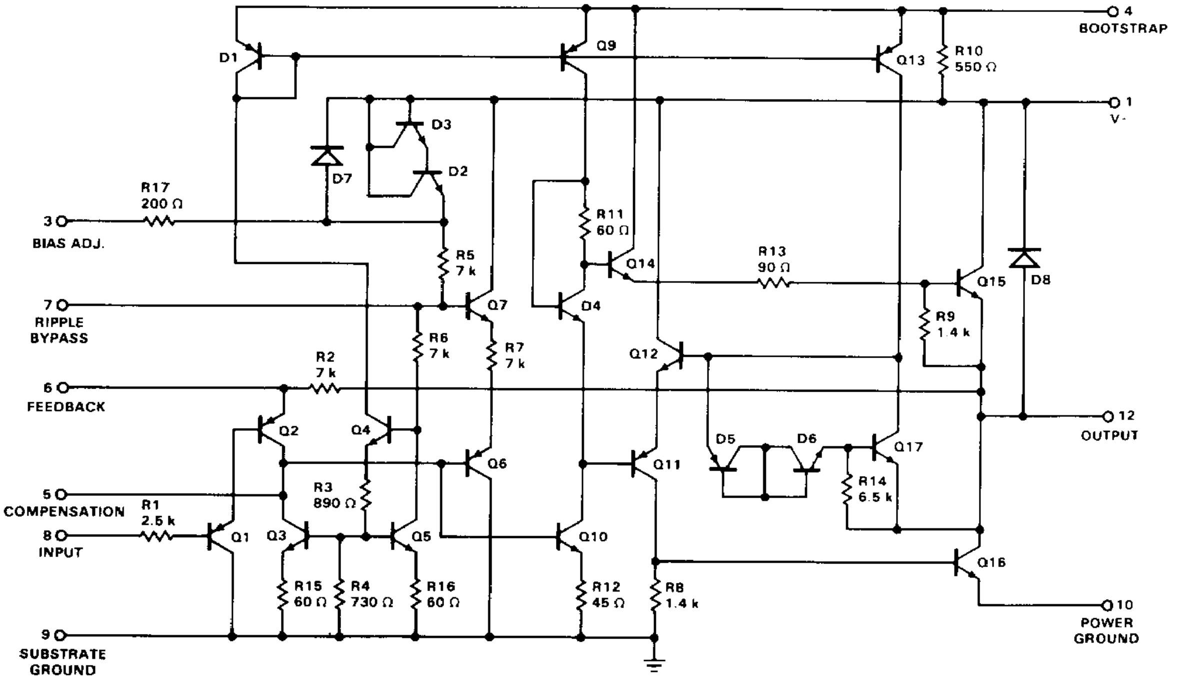


ORDER INFORMATION

TYPE	PART NO.
800 (P3)	TBA800
800A (P4)	TBA800A

*Planar is a patented Fairchild process.

EQUIVALENT CIRCUIT



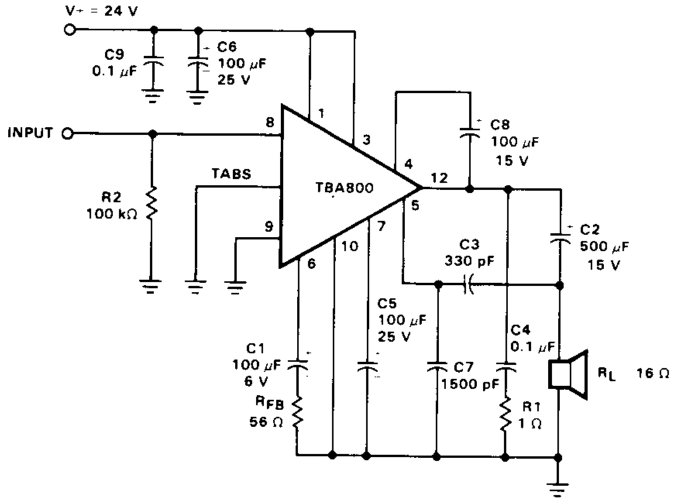
ELECTRICAL CHARACTERISTICS: T_A = 25°C (see Test Circuit)

CHARACTERISTICS	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage		5.0		30	V
Quiescent Output Voltage (Pin 12)	V+ = 24 V	11	12	13	V
Quiescent Drain Current (Pin 1)	V+ = 24 V		9.0	20	mA
Bias Current (Pin 8)	V+ = 24 V		1.0	5.0	μA
Output Power	THD = 10%, R_L = 16 Ω, V+ = 24 V, f = 1 kHz	4.4	5.0		W
Input Saturation Voltage (rms)		220			mV
Input Sensitivity (rms)	P_{OUT} = 5 W, V+ = 24 V, R_L = 16 Ω, f = 1 kHz		80		mV
Input Resistance (Pin 8)			5.0		MΩ
Frequency Response −3.0 dB	V+ = 24 V, R_L = 16 Ω, C_3 = 330 pF		40 – 20,000		Hz
Total Harmonic Distortion	P_{OUT} = 50 mW to 2.5 W, V+ = 24 V, R_L = 16 Ω, f = 1 kHz		0.5		%
Voltage Gain (Open Loop)	V+ = 24 V, R_L = 16 Ω, f = 1 kHz		80		dB
Voltage Gain (Closed Loop)	V+ = 24 V, R_L = 16 Ω, f = 1 kHz	39	42	45	dB
Input Noise Voltage	V+ = 24 V, Rg = 0 Ω, BS (−3.0 dB) = 40–20,000 Hz		5.0		μV
Input Noise Current	V+ = 24 V, BW (−3.0 dB) = 40–20,000 Hz		0.2		nA
Efficiency	P_{OUT} = 5 W, V+ = 24 V, R_L = 16 Ω, f = 1 kHz		75		%

PACKAGE THERMAL RESISTANCE		**TBA800**	**TBA800A**
θJ_{tab}	Thermal resistance junction-tab	max 12 °C/W	10 °C/W
θJ_A	Thermal resistance junction-ambient	max 70* °C/W	80 °C/W

*Obtained with tabs soldered to printed circuit with minimum copper area.

TEST CIRCUIT



C3, C7 see Performance Curves

TYPICAL PERFORMANCE CURVES

OUTPUT POWER AS A FUNCTION OF SUPPLY VOLTAGE

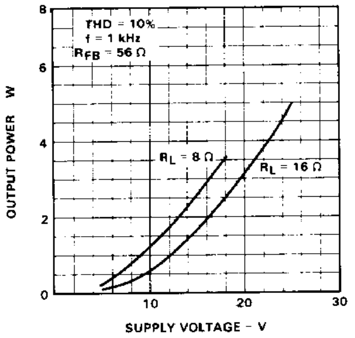


Fig. 1

MAXIMUM POWER DISSIPATION AS A FUNCTION OF SUPPLY VOLTAGE

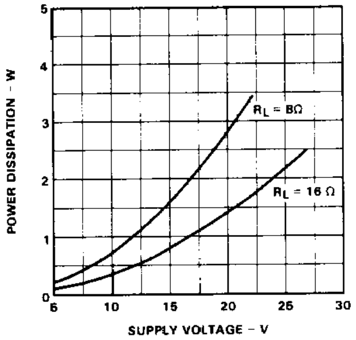


Fig. 2

TOTAL HARMONIC DISTORTION AS A FUNCTION OF OUTPUT POWER

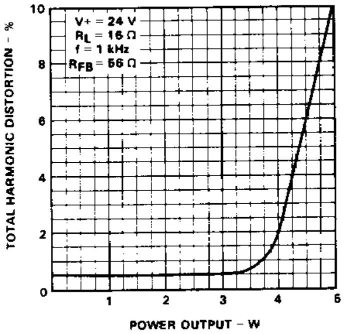


Fig. 3

TOTAL HARMONIC DISTORTION AS A FUNCTION OF FREQUENCY

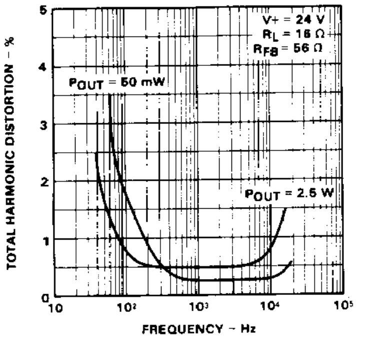


Fig. 4

VALUE OF C3 AS A FUNCTION RFB FOR VARIOUS VALUES OF BW

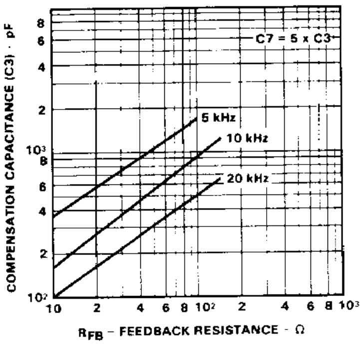


Fig. 5

VOLTAGE GAIN (CLOSED LOOP) AND INPUT VOLTAGE AS A FUNCTION OF RFB

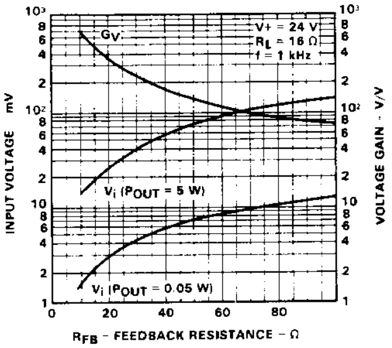


Fig. 6

POWER DISSIPATION AND EFFICIENCY AS A FUNCTION OF OUTPUT POWER

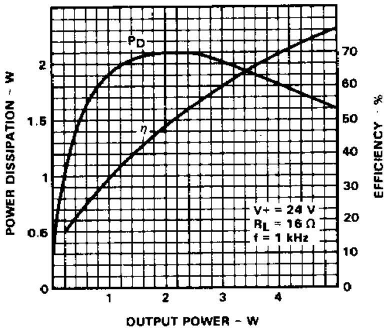


Fig. 7

QUIESCENT OUTPUT VOLTAGE (PIN 12) AS A FUNCTION OF SUPPLY VOLTAGE

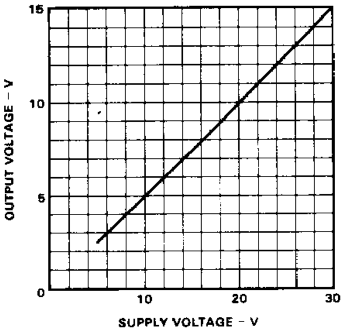


Fig. 8

QUIESCENT CURRENT AS A FUNCTION OF SUPPLY VOLTAGE

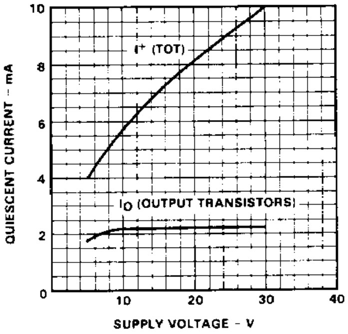


Fig. 9

TYPICAL PERFORMANCE CURVES (cont'd)

TOTAL HARMONIC DISTORTION AS A FUNCTION OF OUTPUT POWER (FIG. 15 CIRCUIT)

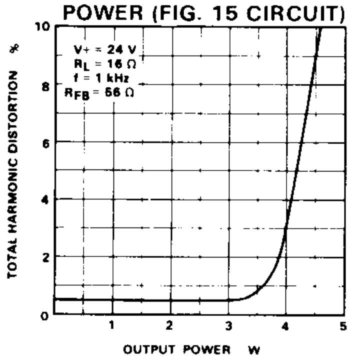


Fig. 10

OUTPUT POWER VERSUS SUPPLY VOLTAGE (FIG. 15 CIRCUIT)

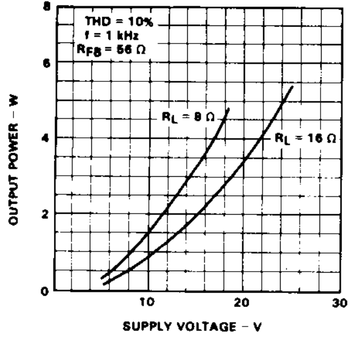


Fig. 11

POWER THAT CAN BE DISSIPATED AS A FUNCTION OF COPPER LENGTH

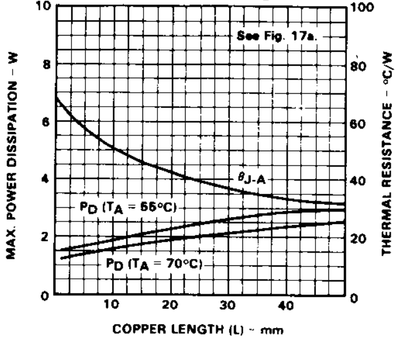


Fig. 12

POWER RATING CHARACTERISTICS

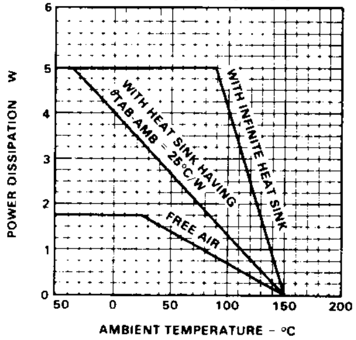
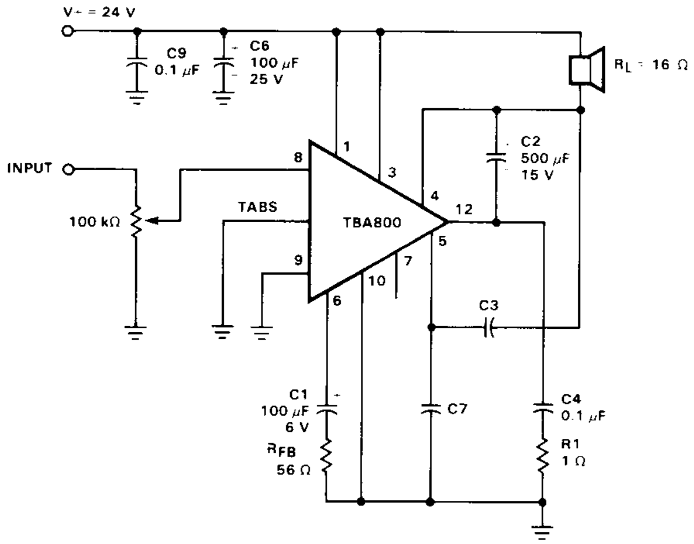


Fig. 13

APPLICATION INFORMATION

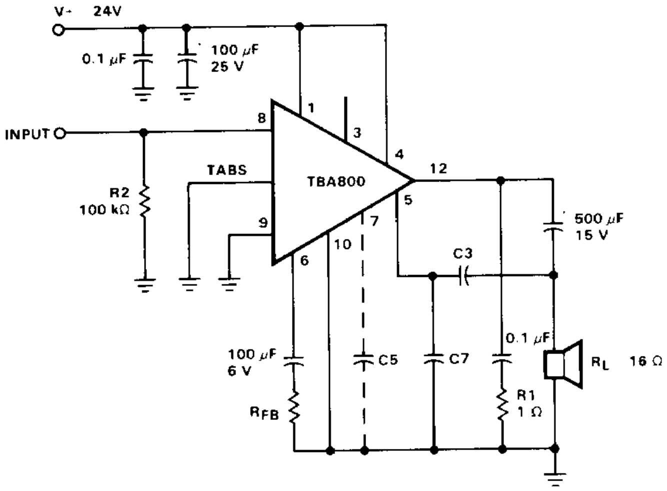


NOTE: Compared with the other circuits, this configuration uses a smaller number of external components and can be used at low supply voltages.

C3, C7 see Performance Curves

Fig. 14. Circuit with the Load Connected to the Supply Voltage

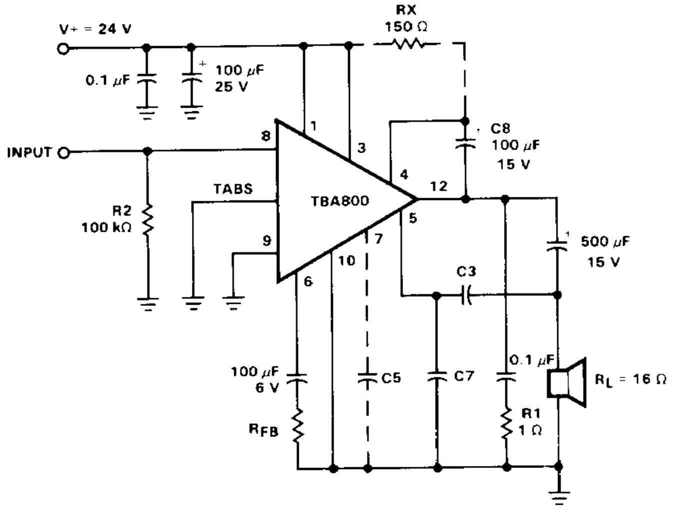
APPLICATION INFORMATION (Cont'd)



NOTE: This circuit is only for use at high voltages. If pin 3 is left open circuit, this automatically inserts diodes D2 – D3 (see schematic diagram) and enables a symmetrical signal to obtain at the output. Refer to Figs. 10 and 11 for distortion and output power.

C3, C7 see Performance Curves

Fig. 15. Circuit with Load Connected to Ground without Bootstrap

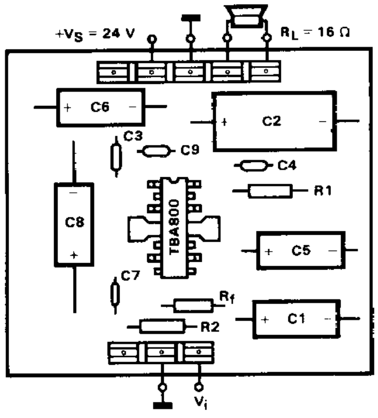


NOTE: The bootstrap capacitor C8 enables the same electrical characteristics as those of the test circuit to be achieved. For low supply voltage operation (*e.g.* 9 to 14 V) RX (150 Ω) is connected between pin 1 and pin 4.

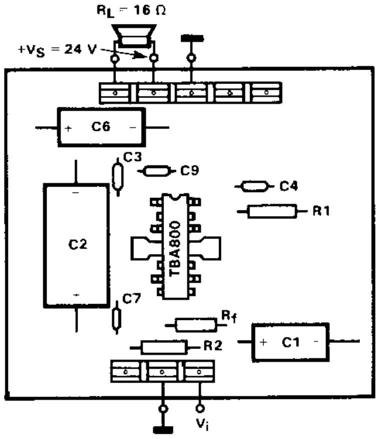
Fig. 16. Circuit with Load Connected to Ground with Bootstrap

NOTE: For the circuits of Fig. 15 and 16 an excellent supply voltage ripple rejection is obtained by connecting the capacitor C5 (10 to 100 μF – 25 V) between pin 7 and ground.

PC Board and Component Layout of the Test Circuit



PC Board Layout (Fig. 14 Circuit)



MOUNTING INSTRUCTIONS – The tabs on the TBA800 can be used to conduct away the heat generated in the integrated circuit so that the junction temperature does not exceed the permissible maximum (150°C). This may be done by connecting tabs to an external heat sink, or by soldering it to a suitable copper area of the printed circuit board (*Fig. 17a*). *Fig. 17b* shows a simple type of heat sink. Assuming an area of copper on the printed circuit board of only 2 cm^2, the total θ between junction to ambient is approximately 30°C/W.

For TBA800A, the desired thermal resistance is obtained attaching the hardware shown in *Fig. 17c*, to a bracket with proper dimensions. This bracket can also act as a support for the whole printed circuit board.

External heat sink or printed circuit copper area must be connected to electrical ground.

In the latter case, *Fig. 12* shows the maximum dissipated power (for T_A = 55°C) as a function of the side of two equal square copper areas having a thickness of 35 μ (1.4 mils).

Fig. 17a. Example of an area of PC board copper soldered to the tabs of the TBA800, which is used as a heat dissipator.

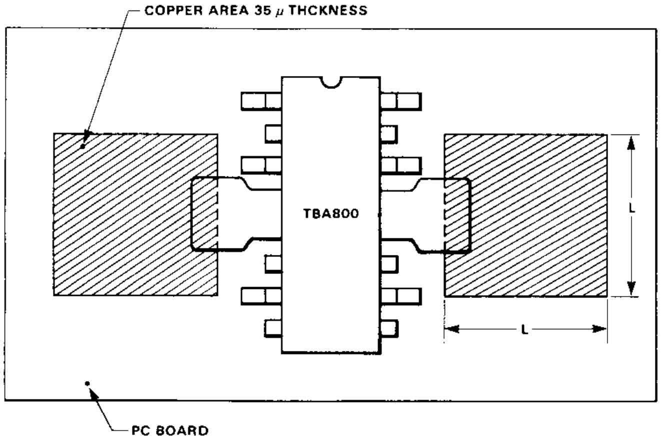


Fig. 17b. Example of TBA800 with external heat sink.

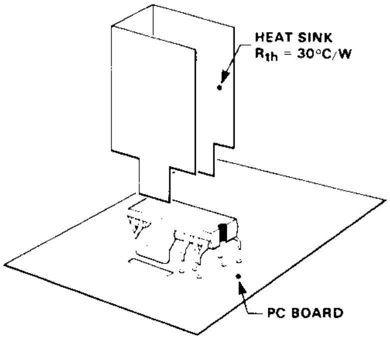
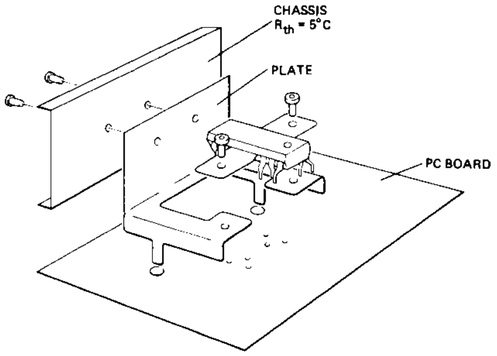


Fig. 17c. Example of TBA800A with external heat sink.



PROCEDURE TO CALCULATE AREA OF COPPER NEEDED

1) Calculate maximum power dissipation

$$P_D = 0.4 \cdot \frac{V+^2_{max}}{8\,R_L} + V+_{max}\,I+$$

where

$V+_{max}$ = maximum value of supply voltage (increase 10% if not stabilized)

R_L = load resistance

$I+$ = quiescent drain current for typical value see *Fig. 9*; maximum value at V+ = 24 V is 20 mA (for worst case design)

$T_{A\ max}$ = 70°C

2) From *Fig. 12*, and knowing $T_{A(max)}$, calculate copper length ("L")

Examples:

a) V+ (not stabilized) = 24 V; R_L = 16 Ω

$$P_D = 0.4 \cdot \frac{(24 + 2.4)^2}{8 \cdot 16} + (24 + 2.4) \cdot 20 \cdot 10^{-3} = 2.6\,W$$

From *Fig. 12* L ≅ 25 mm

For geometries different from the one of *Fig. 17* note that copper areas near the tabs have better efficiency as regards power dissipation. Therefore additional safety factors must be added for worst case designs.

b) V+ (stabilized) = 12 V; R_L = 8 Ω

$$P_D = 0.4 \cdot \frac{12^2}{8 \cdot 8} + 0.02 \cdot 12 = 1\,W$$

The *Fig. 12* shows that no heat sink is required if $T_A \leqslant 55°C$.