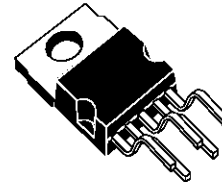


12W AUDIO AMPLIFIER

DESCRIPTION

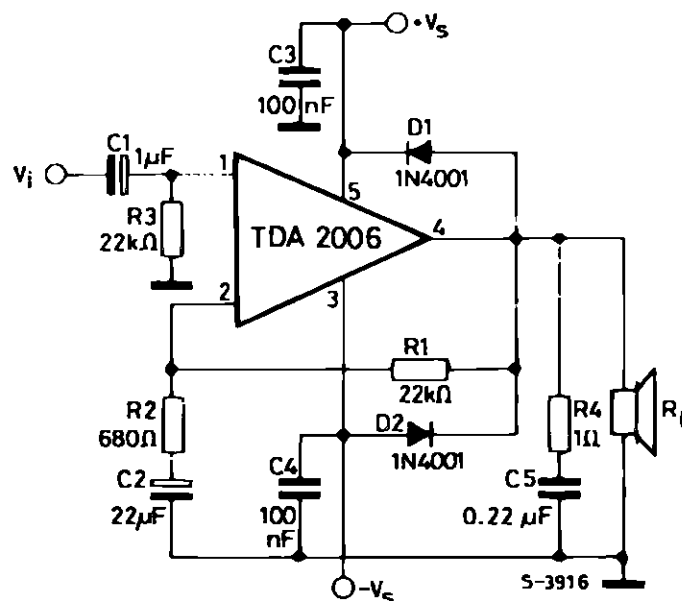
The TDA2006 is a monolithic integrated circuit in Pentawatt package, intended for use as a low frequency class "AB" amplifier. At $\pm 12V$, $d = 10\%$ typically it provides 12W output power on a 4Ω load and 8W on a 8Ω . The TDA2006 provides high output current and has very low harmonic and cross-over 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 shutdown system is also included. The TDA2006 is pin to pin equivalent to the TDA2030.



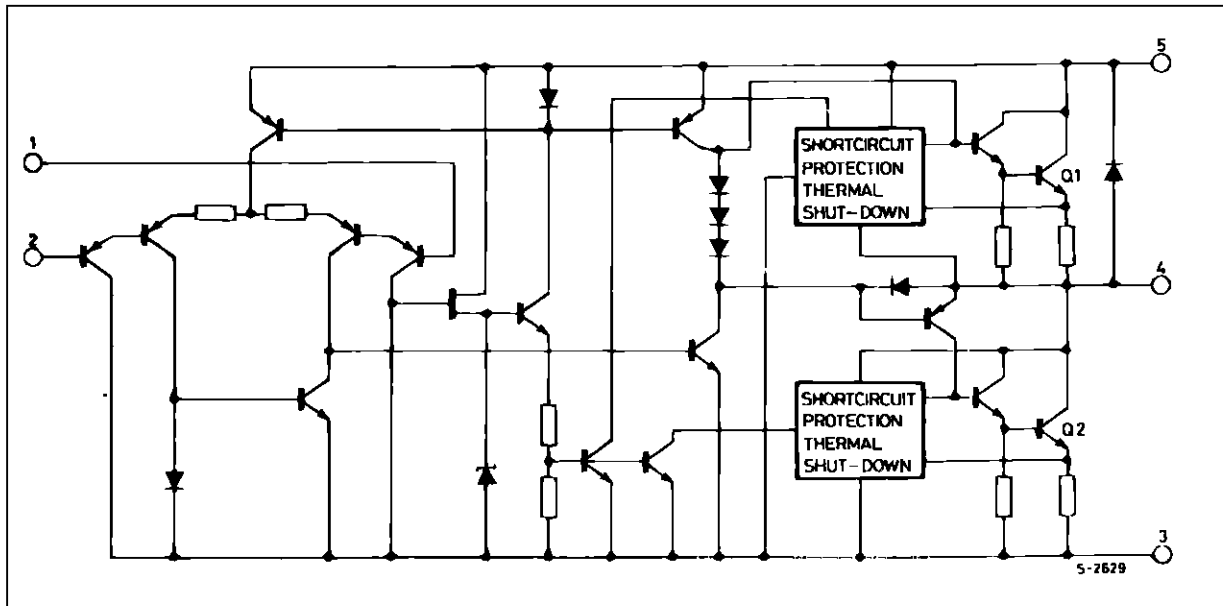
PENTAWATT

ORDERING NUMBERS : TDA2006V
TDA2006H

TYPICAL APPLICATION CIRCUIT



SCHEMATIC DIAGRAM



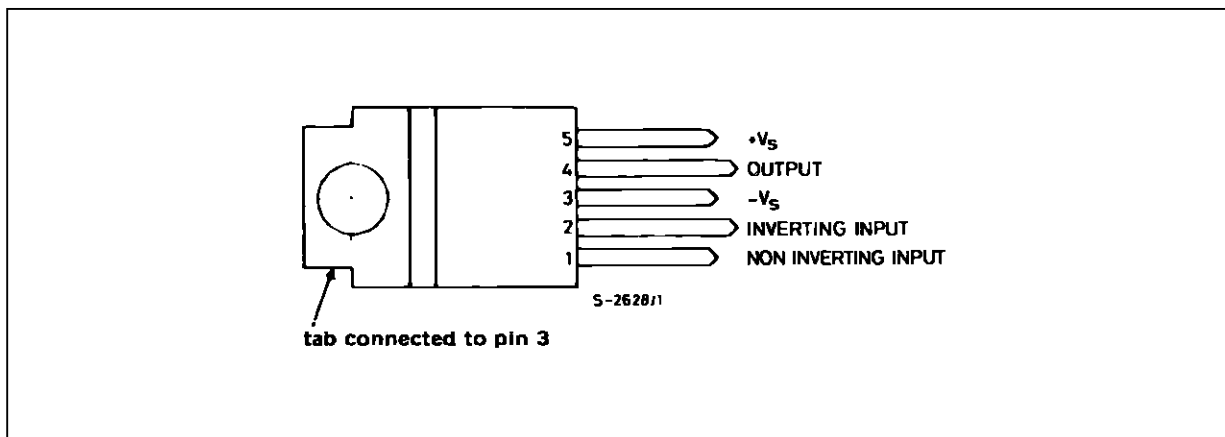
ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|----------------|----------------------------------------------------|-------------|------------------|
| V_s | Supply Voltage | ± 15 | V |
| V_i | Input Voltage | V_s | |
| V_i | Differential Input Voltage | ± 12 | V |
| I_o | Output Peak Current (internally limited) | 3 | A |
| P_{tot} | Power Dissipation at $T_{case} = 90^\circ\text{C}$ | 20 | W |
| T_{stg}, T_j | Storage and Junction Temperature | - 40 to 150 | $^\circ\text{C}$ |

THERMAL DATA

| Symbol | Parameter | Value | Unit |
|---------------|--------------------------------------|-------|--------------------|
| $R_{th(j-c)}$ | Thermal Resistance Junction-case Max | 3 | $^\circ\text{C/W}$ |

PIN CONNECTION



ELECTRICAL CHARACTERISTICS(refer to the test circuit ; $V_S = \pm 12V$, $T_{amb} = 25^\circ C$ unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------|---------------------------------------|----------------------------------------------------------------------------------------------------------|----------------|------------|-----------|------------|
| V_S | Supply Voltage | | ± 6 | | ± 15 | V |
| I_d | Quiescent Drain Current | $V_S = \pm 15V$ | | 40 | 80 | mA |
| I_b | Input Bias Current | $V_S = \pm 15V$ | | 0.2 | 3 | μA |
| V_{OS} | Input Offset Voltage | $V_S = \pm 15V$ | | ± 8 | | mV |
| I_{OS} | Input Offset Current | $V_S = \pm 15V$ | | ± 80 | | nA |
| V_{OS} | Output Offset Voltage | $V_S = \pm 15V$ | | ± 10 | ± 100 | mV |
| P_o | Output Power | $d = 10\%$, $f = 1kHz$ $R_L = 4\Omega$ $R_L = 8\Omega$ | 6 | 12 8 | | W |
| d | Distortion | $P_o = 0.1$ to $8W$, $R_L = 4\Omega$, $f = 1kHz$ $P_o = 0.1$ to $4W$, $R_L = 8\Omega$, $f = 1kHz$ | | 0.2 0.1 | | % % |
| V_i | Input Sensitivity | $P_o = 10W$, $R_L = 4\Omega$, $f = 1kHz$ $P_o = 6W$, $R_L = 8\Omega$, $f = 1kHz$ | | 200 220 | | mV mV |
| B | Frequency Response ($-3dB$) | $P_o = 8W$, $R_L = 4\Omega$ | 20Hz to 100kHz | | | |
| R_i | Input Resistance (pin 1) | $f = 1kHz$ | 0.5 | 5 | | $M\Omega$ |
| G_v | Voltage Gain (open loop) | $f = 1kHz$ | | 75 | | dB |
| G_v | Voltage Gain (closed loop) | $f = 1kHz$ | 29.5 | 30 | 30.5 | dB |
| e_N | Input Noise Voltage | $B (-3dB) = 22Hz$ to $22kHz$, $R_L = 4\Omega$ | | 3 | 10 | μV |
| i_N | Input Noise Current | $B (-3dB) = 22Hz$ to $22kHz$, $R_L = 4\Omega$ | | 80 | 200 | pA |
| SVR | Supply Voltage Rejection | $R_L = 4\Omega$, $R_g = 22k\Omega$, $f_{ripple} = 100Hz$ (*) | 40 | 50 | | dB |
| I_d | Drain Current | $P_o = 12W$, $R_L = 4\Omega$ $P_o = 8W$, $R_L = 8\Omega$ | | 850 500 | | mA mA |
| T_j | Thermal Shutdown Junction Temperature | | | | 145 | $^\circ C$ |

(*) Referring to Figure 15, single supply.

Figure 1 : Output Power versus Supply Voltage

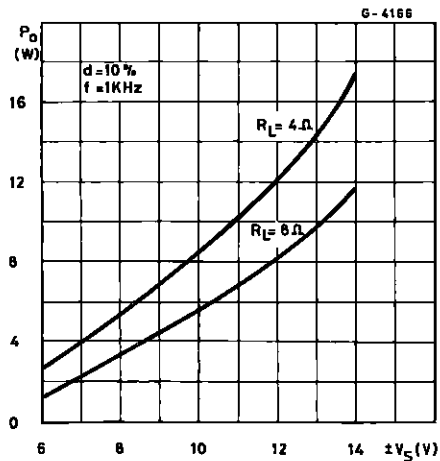


Figure 2 : Distortion versus Output Power

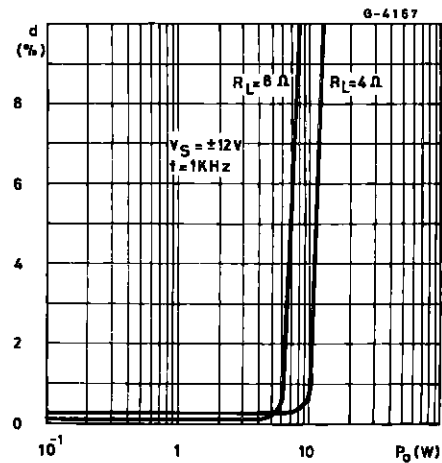


Figure 3 : Distortion versus Frequency

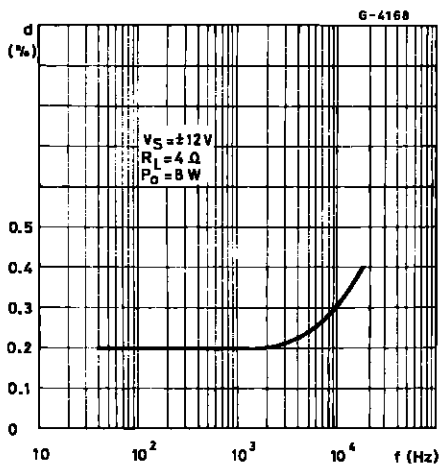


Figure 4 : Distortion versus Frequency

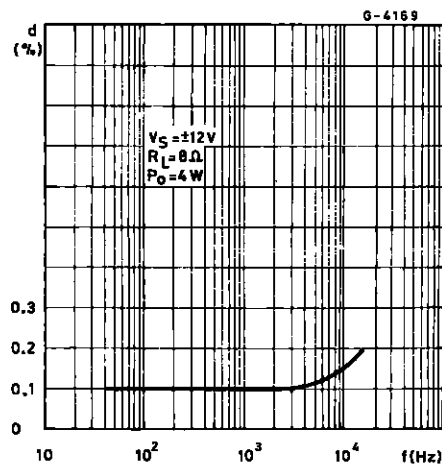


Figure 5 : Sensitivity versus Output Power

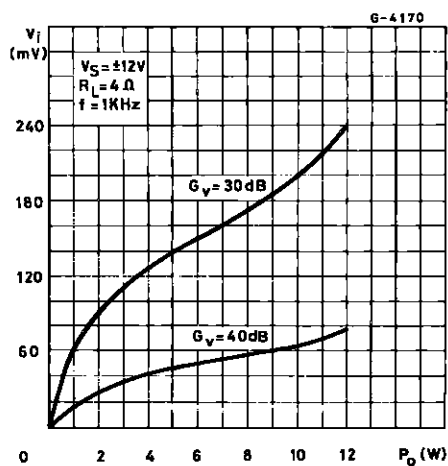


Figure 6 : Sensitivity versus Output Power

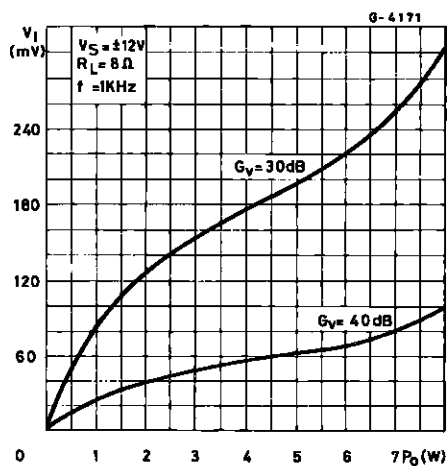


Figure 7 : Frequency Response with different values of the rolloff Capacitor C8 (see Figure 13)

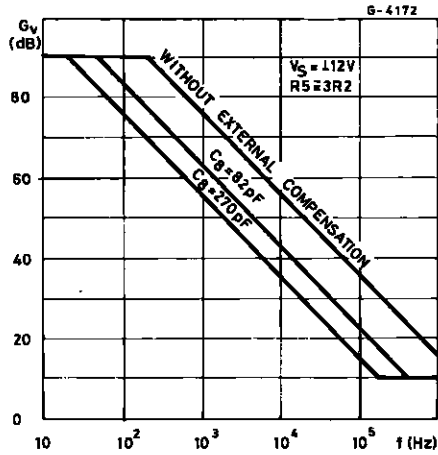


Figure 8 : Value of C8 versus Voltage Gain for different Bandwidths (see Figure 13)

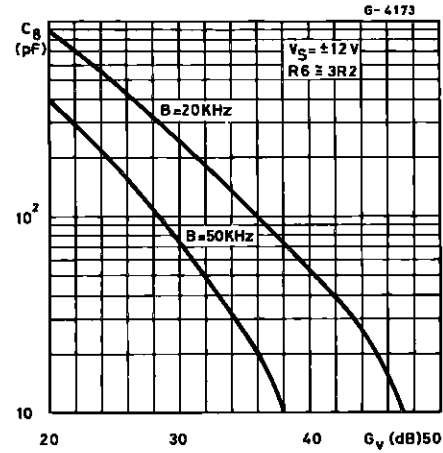


Figure 9 : Quiescent Current versus Supply Voltage

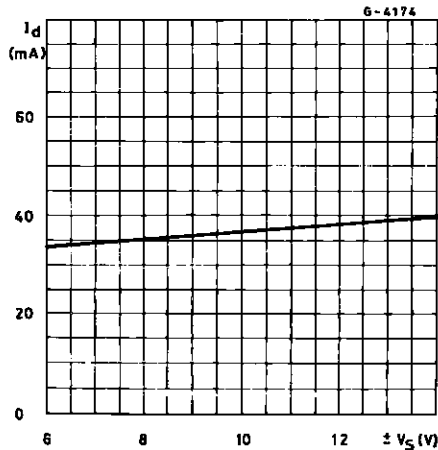


Figure 10 : Supply Voltage Rejection versus Voltage Gain

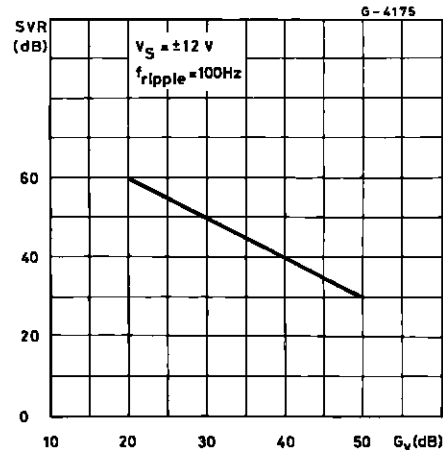


Figure 11 : Power Dissipation and Efficiency versus Output Power

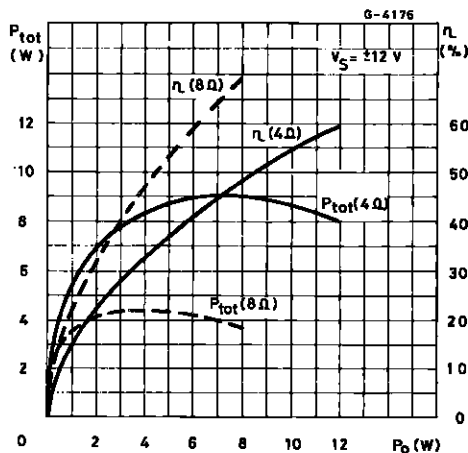


Figure 12 : Maximum Power Dissipation versus Supply Voltage (sine wave operation)

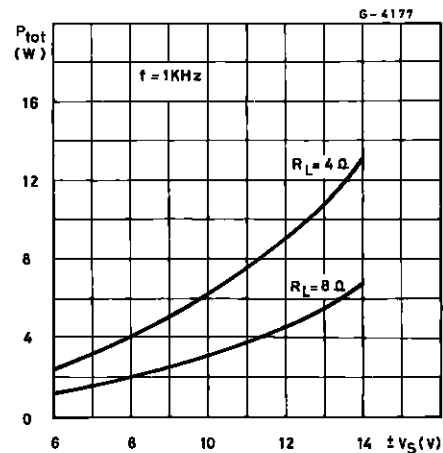


Figure 13 : Application Circuit with Split Power Supply

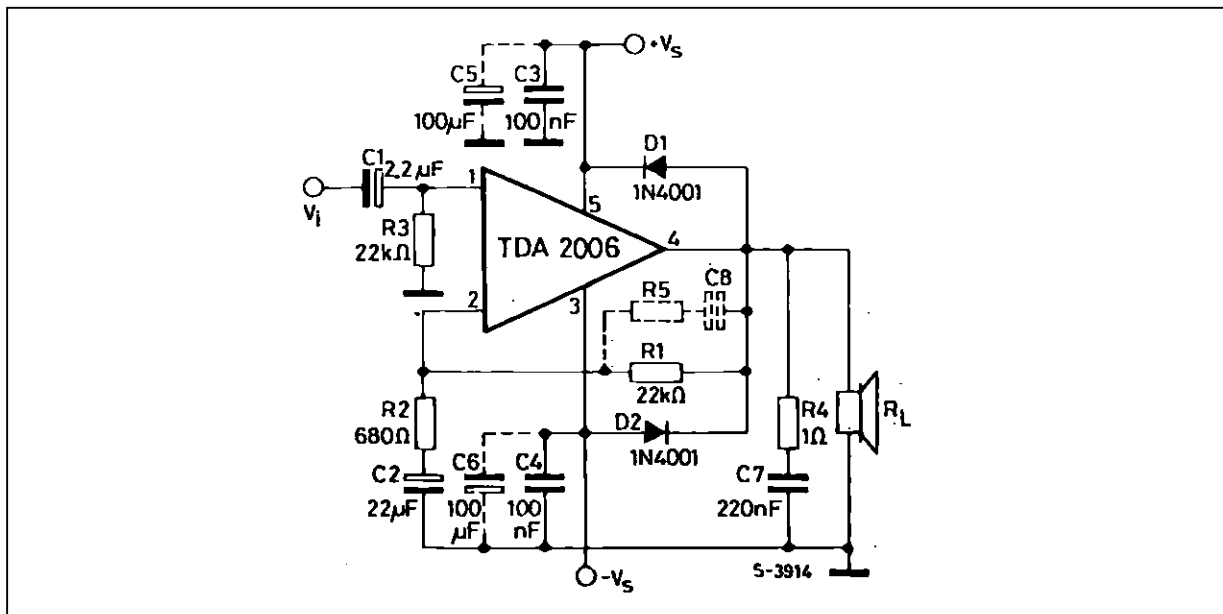


Figure 14 : P.C. Board and Components Layout of the Circuit of Figure 13 (1:1 scale)

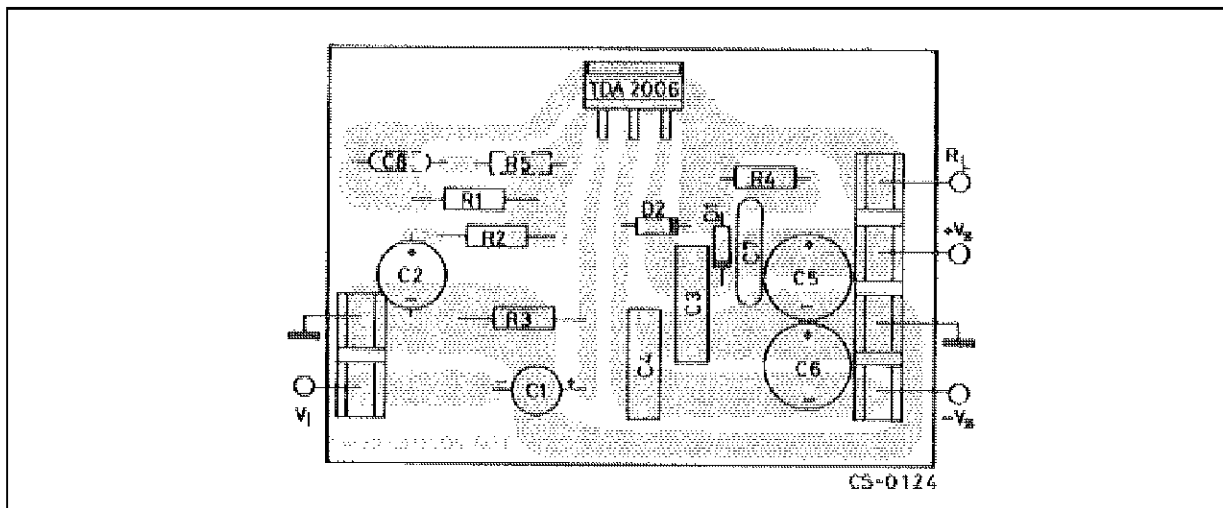


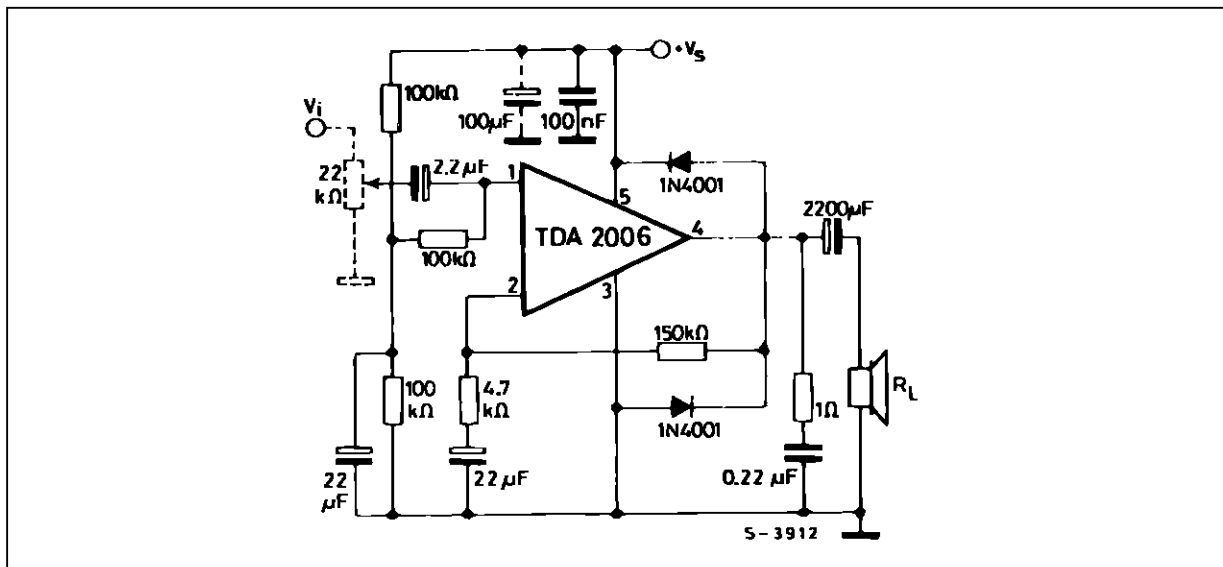
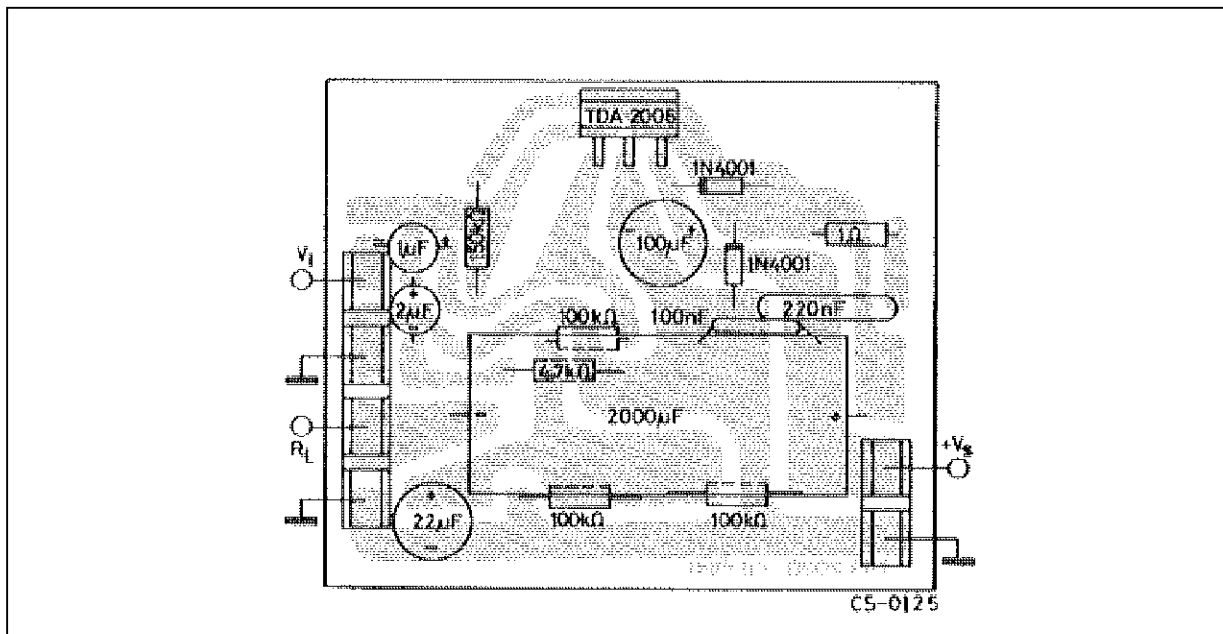
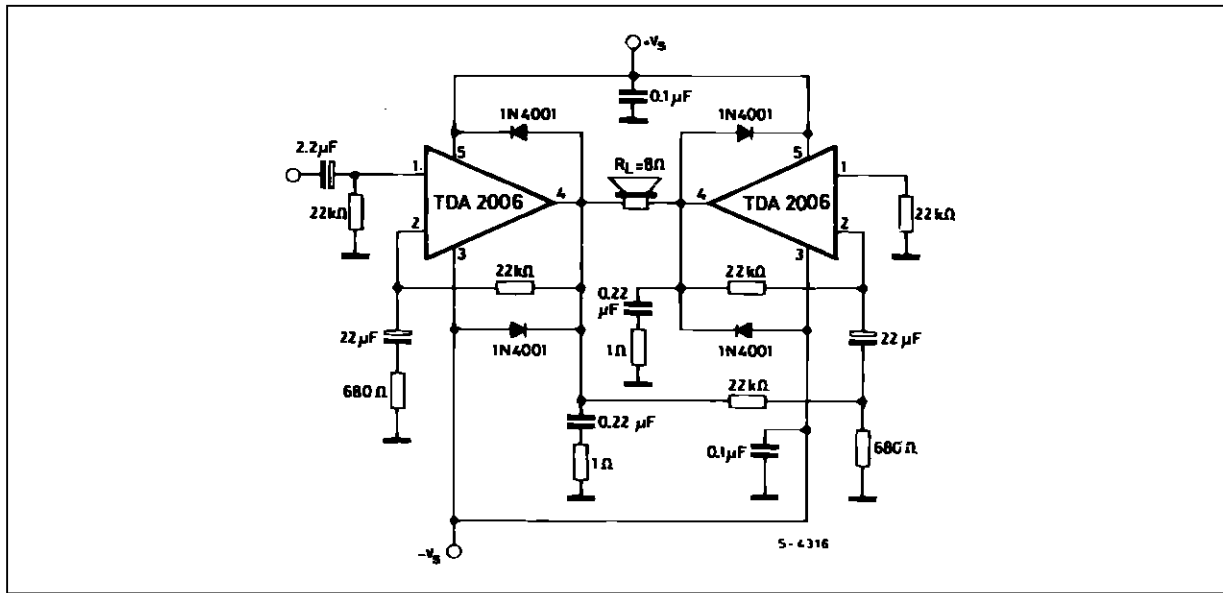
Figure 15 : Application Circuit with Single Power Supply**Figure 16** : P.C. Board and Components Layout of the Circuit of Figure 15 (1:1 scale)

Figure 17 : Bridge Amplifier Configuration with Split Power Supply ($P_o = 24W$, $V_s = \pm 12V$)

PRACTICAL CONSIDERATIONS

Printed Circuit Board

The layout shown in Figure 14 should be adopted by the designers. If different layout are used, the ground points of input 1 and input 2 must be well decoupled from ground of the output on which a rather high current flows.

Assembly Suggestion

No electrical isolation is needed between the pack-

age and the heat-sink with single supply voltage configuration.

Application Suggestion

The recommended values of the components are the ones shown on application circuits of Figure 13. Different values can be used. The table 1 can help the designers.

Table 1

| Component | Recommended Value | Purpose | Larger Than Recommended Value | Smaller Than Recommended Value |
|-------------------------------|-----------------------|------------------------------------------------------|----------------------------------------------------------------|-------------------------------------|
| R ₁ | 22 kΩ | Closed Loop Gain Setting | Increase of Gain | Decrease of Gain (*) |
| R ₂ | 680 Ω | Closed Loop Gain Setting | Decrease of Gain (*) | Increase of Gain |
| R ₃ | 22 kΩ | Non Inverting Input Biasing | Increase of Input Impedance | Decrease of Input Impedance |
| R ₄ | 1 Ω | Frequency Stability | Danger of Oscillation at High Frequencies with Inductive Loads | |
| R ₅ | 3 R ₂ | Upper Frequency Cut-off | Poor High Frequencies Attenuation | Danger of Oscillation |
| C ₁ | 2.2 μF | Input DC Decoupling | | Increase of Low Frequencies Cut-off |
| C ₂ | 22 μF | Inverting Input DC Decoupling | | Increase of Low Frequencies Cut-off |
| C ₃ C ₄ | 0.1 μF | Supply Voltage by Pass | | Danger of Oscillation |
| C ₅ C ₆ | 100 μF | Supply Voltage by Pass | | Danger of Oscillation |
| C ₇ | 0.22 μF | Frequency Stability | | Danger of Oscillation |
| C ₈ | $\frac{1}{2\pi BR_1}$ | Upper Frequency Cut-off | Lower Bandwidth | Larger Bandwidth |
| D ₁ D ₂ | 1N4001 | To Protect the Device Against Output Voltage Spikes. | | |

(*) Closed loop gain must be higher than 24dB.

SHORT CIRCUIT PROTECTION

The TDA2006 has an original circuit which limits the current of the output transistors. Figure 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 (Figure 19).

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.

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 shutdown simply reduces the power dissipation and the current consumption.

The maximum allowable power dissipation depends upon the size of the external heatsink (i.e. its thermal resistance) ; Figure 22 shows the dissippable power as a function of ambient temperature for different thermal resistances.

Figure 18 : Maximum Output Current versus Voltage V_{CE} (sat) across each Output Transistor

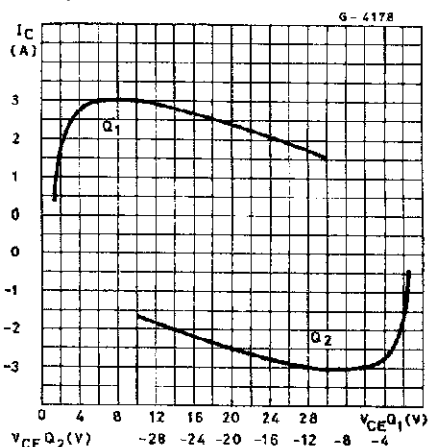


Figure 19 : Safe Operating Area and Collector Characteristics of the Protected Power Transistor

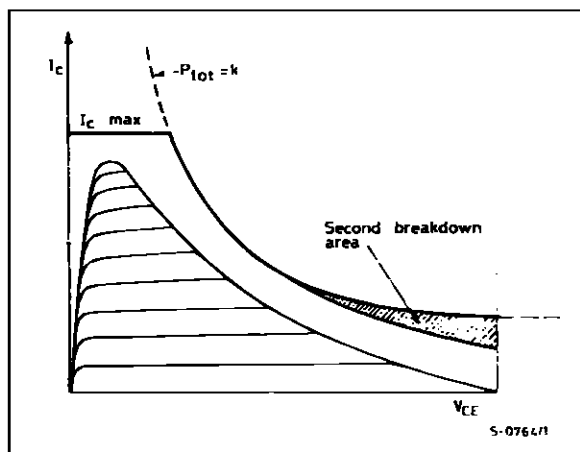


Figure 20 : Output Power and Drain Current versus Case Temperature ($R_L = 4\Omega$)

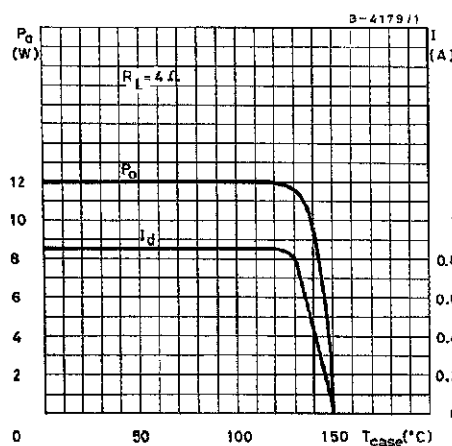


Figure 21 : Output Power and Drain Current versus Case Temperature ($R_L = 8\Omega$)

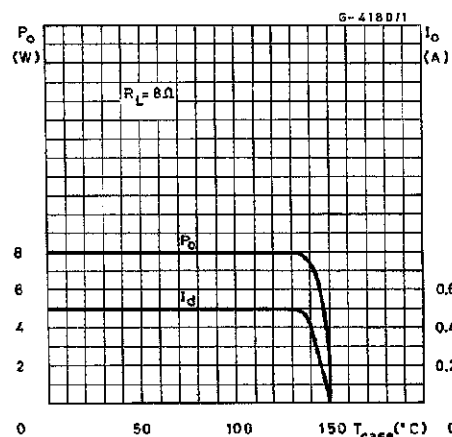
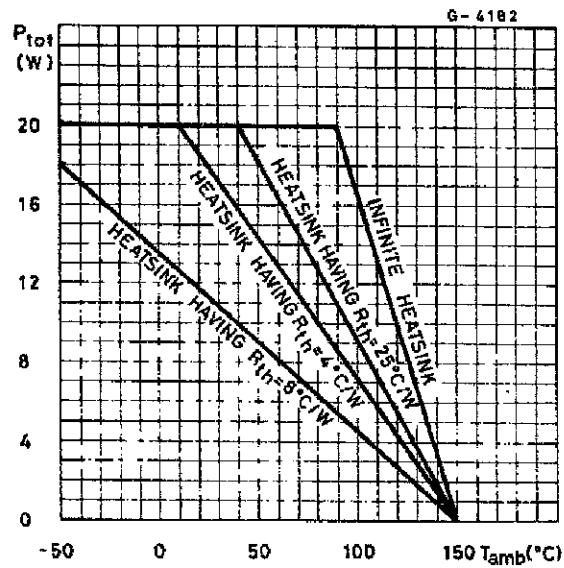


Figure 22 : Maximum Allowable Power Dissipation versus Ambient Temperature

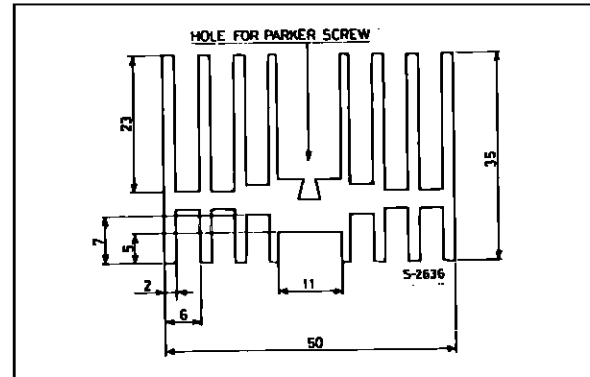


DIMENSION SUGGESTION

The following table shows the length of the heatsink in Figure 23 for several values of P_{tot} and R_{th} .

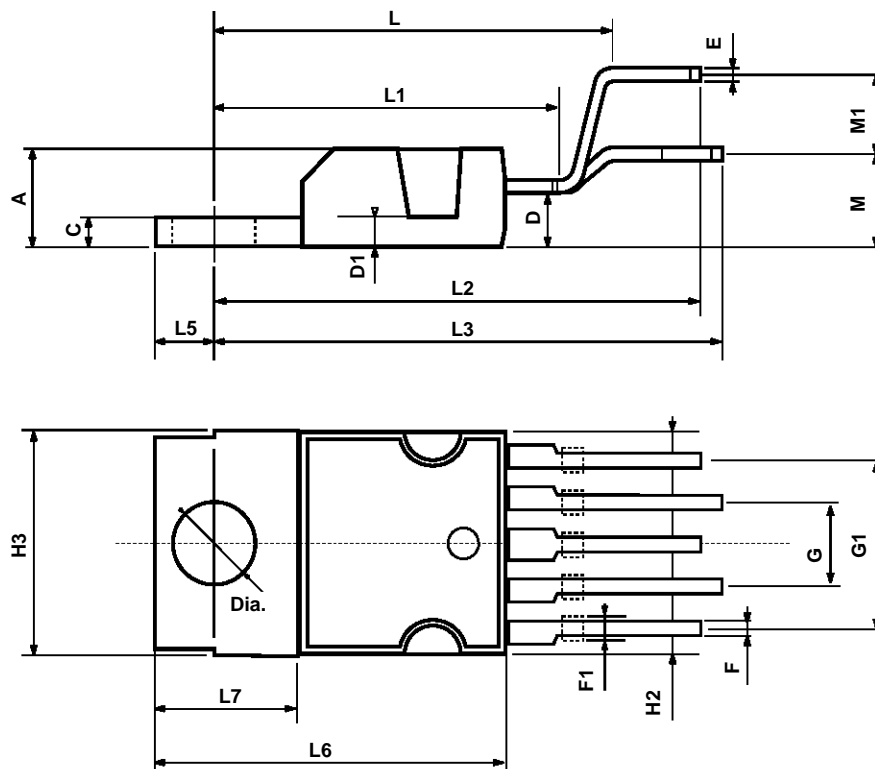
| P_{tot} (W) | 12 | 8 | 6 |
|----------------------------------------|-----|-----|-----|
| Length of Heatsink (mm) | 60 | 40 | 30 |
| R_{th} of Heatsink ($^{\circ}C/W$) | 4.2 | 6.2 | 8.3 |

Figure 23 : Example of Heatsink



PENTAWATT PACKAGE MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|-------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 4.8 | | | 0.189 |
| C | | | 1.37 | | | 0.054 |
| D | 2.4 | | 2.8 | 0.094 | | 0.110 |
| D1 | 1.2 | | 1.35 | 0.047 | | 0.053 |
| E | 0.35 | | 0.55 | 0.014 | | 0.022 |
| F | 0.8 | | 1.05 | 0.031 | | 0.041 |
| F1 | 1 | | 1.4 | 0.039 | | 0.055 |
| G | | 3.4 | | 0.126 | 0.134 | 0.142 |
| G1 | | 6.8 | | 0.260 | 0.268 | 0.276 |
| H2 | | | 10.4 | | | 0.409 |
| H3 | 10.05 | | 10.4 | 0.396 | | 0.409 |
| L | | 17.85 | | | 0.703 | |
| L1 | | 15.75 | | | 0.620 | |
| L2 | | 21.4 | | | 0.843 | |
| L3 | | 22.5 | | | 0.886 | |
| L5 | 2.6 | | 3 | 0.102 | | 0.118 |
| L6 | 15.1 | | 15.8 | 0.594 | | 0.622 |
| L7 | 6 | | 6.6 | 0.236 | | 0.260 |
| M | | 4.5 | | | 0.177 | |
| M1 | | 4 | | | 0.157 | |
| Dia | 3.65 | | 3.85 | 0.144 | | 0.152 |



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