

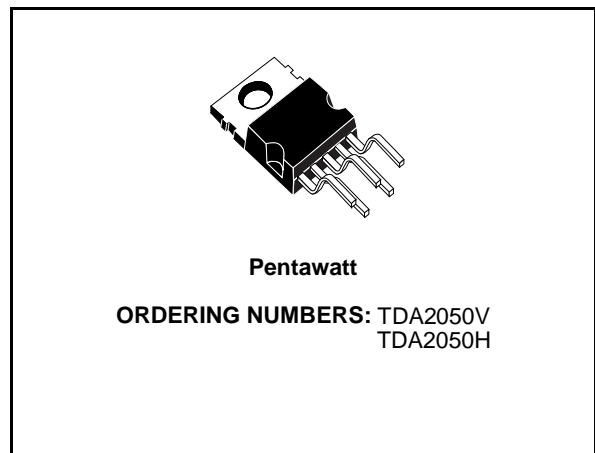
32W Hi-Fi AUDIO POWER AMPLIFIER

- HIGH OUTPUT POWER
(50W MUSIC POWER IEC 268.3 RULES)
- HIGH OPERATING SUPPLY VOLTAGE (50V)
- SINGLE OR SPLIT SUPPLY OPERATIONS
- VERY LOW DISTORTION
- SHORT CIRCUIT PROTECTION (OUT TO GND)
- THERMAL SHUTDOWN

DESCRIPTION

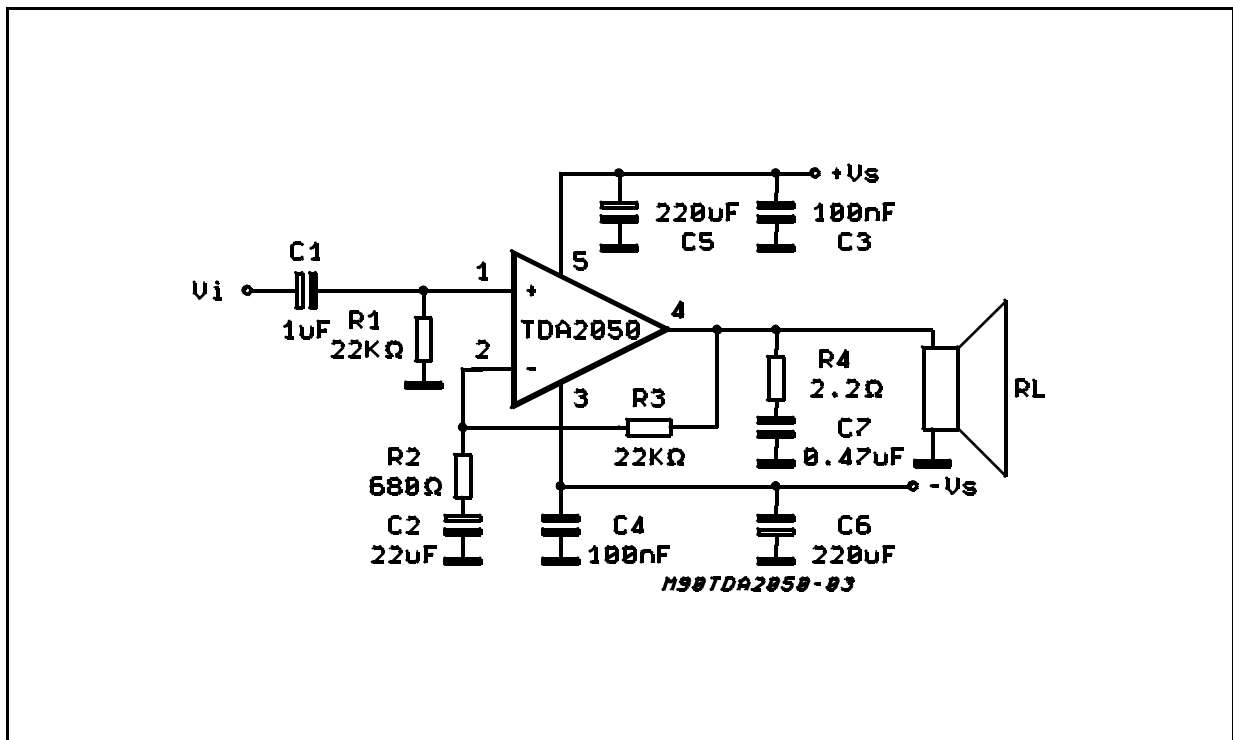
The TDA 2050 is a monolithic integrated circuit in Pentawatt package, intended for use as an audio class AB audio amplifier. Thanks to its high power capability the TDA2050 is able to provide up to 35W true rms power into 4 ohm load @ THD = 10%, $V_s = \pm 18V$, $f = 1KHz$ and up to 32W into 8ohm load @ THD = 10%, $V_s = \pm 22V$, $f = 1KHz$.

Moreover, the TDA 2050 delivers typically 50W music power into 4 ohm load over 1 sec at $V_s = 22.5V$, $f = 1KHz$.



The high power and very low harmonic and cross-over distortion (THD = 0.05% typ, @ $V_s = \pm 22V$, $P_o = 0.1$ to 15W, $R_L = 8ohm$, $f = 100Hz$ to 15KHz) make the device most suitable for both HiFi and high class TV sets.

TEST AND APPLICATION CIRCUIT

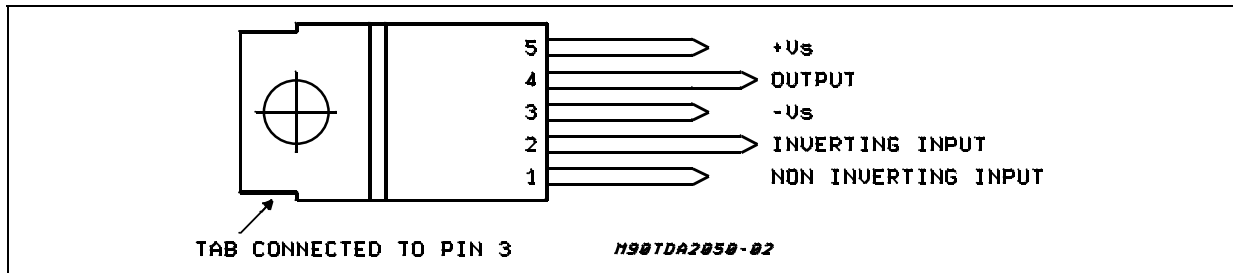


TDA2050

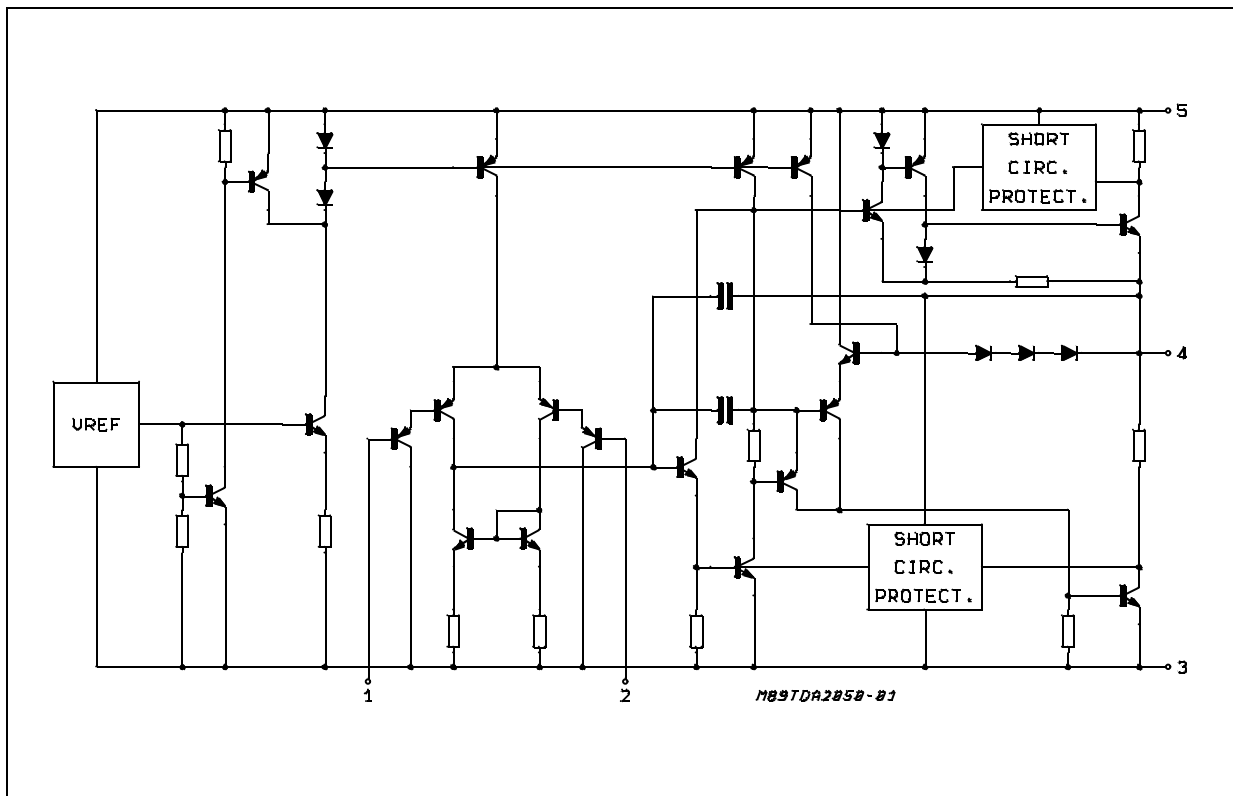
ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|------------|
| V_S | Supply Voltage | ± 25 | V |
| V_i | Input Voltage | V_S | |
| V_i | Differential Input Voltage | ± 15 | V |
| I_o | Output Peak Current (internally limited) | 5 | A |
| P_{tot} | Power Dissipation $T_{CASE} = 75^\circ C$ | 25 | W |
| T_{stg}, T_j | Storage and Junction Temperature | -40 to 150 | $^\circ C$ |

PIN CONNECTION (Top view)



SCHEMATIC DIAGRAM



THERMAL DATA

| Symbol | Description | Value | Unit |
|------------------|----------------------------------|-------|--------------|
| $R_{th\ j-case}$ | Thermal Resistance junction-case | Max 3 | $^\circ C/W$ |

ELECTRICAL CHARACTERISTICS (Refer to the Test Circuit, $V_S = \pm 18V$, $T_{amb} = 25^\circ C$, $f = 1\text{ kHz}$; unless otherwise specified)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|------------|--|--|--------------|----------------|------------|--------------------|
| V_S | Supply Voltage Range | | ± 4.5 | | ± 25 | V |
| I_d | Quiescent Drain Current | $V_S = \pm 4.5V$ $V_S = \pm 25V$ | | 30 55 | 50 90 | mA mA |
| I_b | Input Bias Current | $V_S = \pm 22V$ | | 0.1 | 0.5 | μA |
| V_{OS} | Input Offset Voltage | $V_S = \pm 22V$ | | | ± 15 | mV |
| I_{OS} | Input Offset Current | $V_S = \pm 22V$ | | | ± 200 | nA |
| P_O | RMS Output Power | $d = 0.5\%$ $R_L = 4\Omega$ $R_L = 8\Omega$ $V_S = \pm 22V$ $R_L = 8\Omega$ | 24 | 28 18 | | W W W |
| | | $d = 10\%$ $R_L = 4\Omega$ $R_L = 8\Omega$ $V_S = \pm 22V$ $R_L = 8\Omega$ | | 35 22 32 | | W W W |
| | | Music Power IEC268.3 RULES $d = 10\%$; $T = 1s$ $V_S = \pm 22.5V$; $R_L = 4\Omega$ | | 50 | | W |
| d | Total Harmonic Distortion | $R_L = 4\Omega$ $f = 1\text{kHz}$, $P_O = 0.1$ to $24W$ $f = 100\text{Hz}$ to 10kHz , $P_O = 0.1$ to $18W$ | | 0.03 | 0.5 0.5 | % % |
| | | $V_S = \pm 22V$ $R_L = 8\Omega$ $f = 1\text{kHz}$, $P_O = 0.1$ to $20W$ $f = 100\text{Hz}$ to 10kHz , $P_O = 0.1$ to $15W$ | | 0.02 | 0.5 | % % |
| SR | Slew Rate | | 5 | 8 | | V/ μs |
| G_V | Open Loop Voltage Gain | | | 80 | | dB |
| G_V | Closed Loop Voltage Gain | | 30 | 30.5 | 31 | dB |
| BW | Power Bandwidth (-3dB) | $R_L = 4\Omega$ $V_i = 200mV$ | 20 to 80,000 | | | Hz |
| e_N | Total Input Noise | curve A B = 22Hz to 22kHz | | 4 5 | 10 | μV μV |
| | | | | | | |
| R_i | Input Resistance (pin 1) | | 500 | | | k Ω |
| SVR | Supply Voltage Rejection | $R_S = 22k\Omega$; $f = 100\text{Hz}$; $V_{ripple} = 0.5V_{rms}$ | | 45 | | dB |
| η | Efficiency | $P_O = 28W$; $R_L = 4\Omega$ | | 65 | | % |
| | | $P_O = 25W$; $R_L = 8\Omega$; $V_S = \pm 22V$ | | 67 | | % |
| T_{sd-j} | Thermal Shut-down Junction Temperature | | | 150 | | $^\circ C$ |

Figure 1: Split Supply Typical Application Circuit

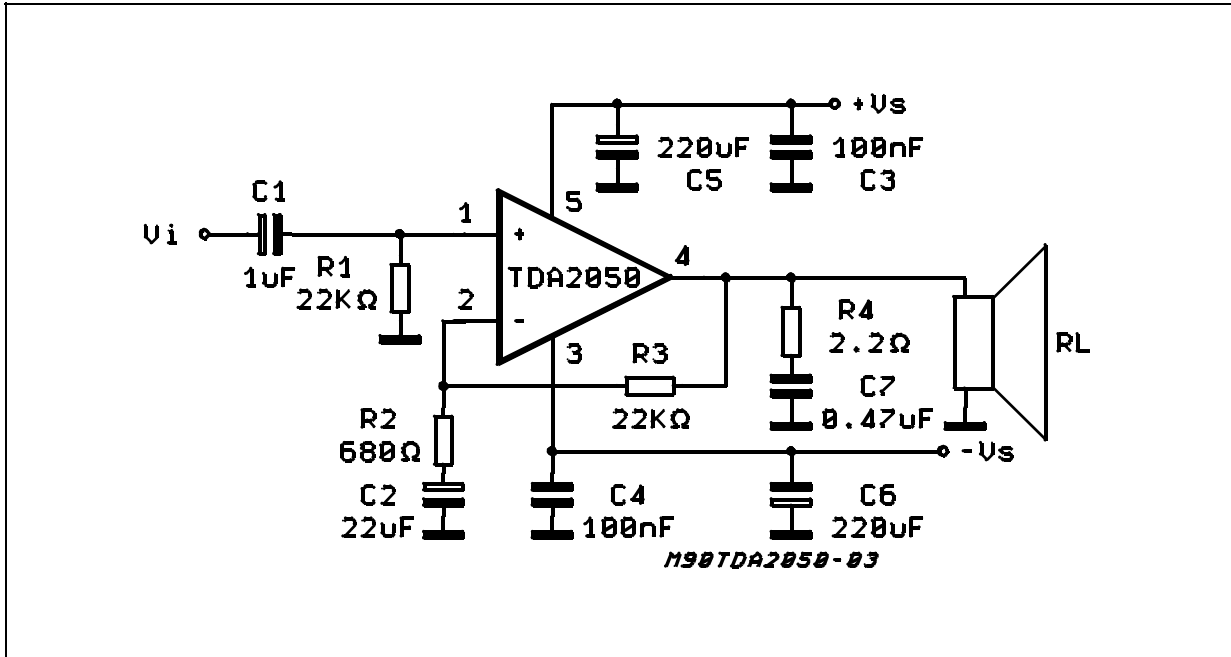
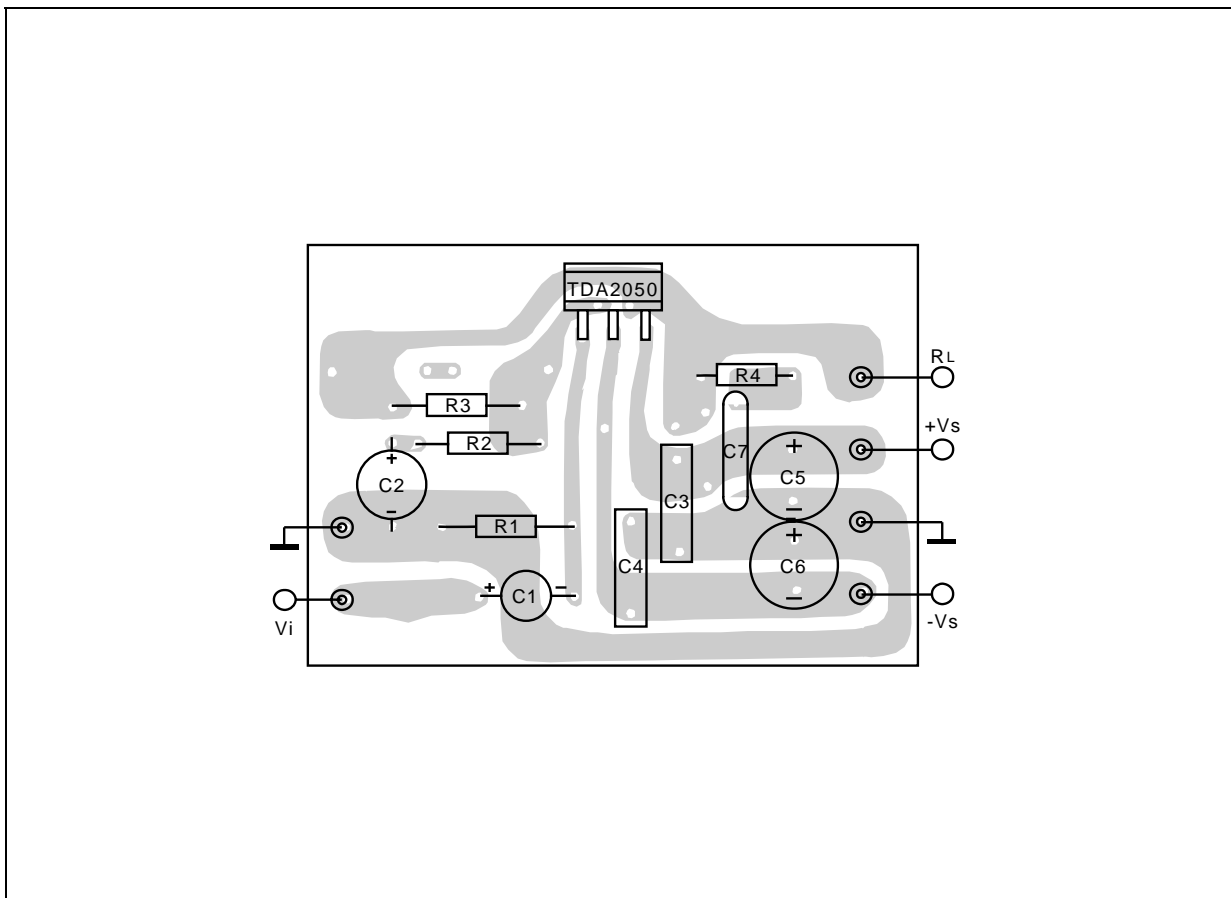


Figure 2: P.C. Board and Components Layout of the Circuit of Fig. 1 (1:1)



SPLIT SUPPLY APPLICATION SUGGESTIONS

The recommended values of the external components are those shown on the application circuit

of fig. 2. Different values can be used. The following table can help the designer.

| Component | Recommended Value | Purpose | Larger than Recommended Value | Smaller than Recommended Value |
|-----------|-------------------|-------------------------------|---------------------------------|--------------------------------|
| R1 | 22k Ω | Input Impedance | Increase of Input Impedance | Decrease of Input Impedance |
| R2 | 680 Ω | Feedback Resistor | Decrease of Gain (*) | Increase of Gain |
| R3 | 22k Ω | | Increase of Gain | Decrease of Gain (*) |
| R4 | 2.2 Ω | Frequency Stability | Danger of Oscillations | |
| C1 | 1 μ F | Input Decoupling DC | | Higher Low-frequency cut-off |
| C2 | 22 μ F | Inverting Input DC Decoupling | Increase of Switch ON/OFF Noise | Higher Low-frequency cut-off |
| C3 C4 | 100nF | Supply Voltage Bypass | | Danger of Oscillations |
| C5 C6 | 220 μ F | Supply Voltage Bypass | | Danger of Oscillations |
| C7 | 0.47 μ F | Frequency Stability | | Danger of Oscillations |

(*) The gain must be higher than 24dB

PRINTED CIRCUIT BOARD

The layout shown in fig. 2 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.

Figure 3: Single Supply Typical Application Circuit

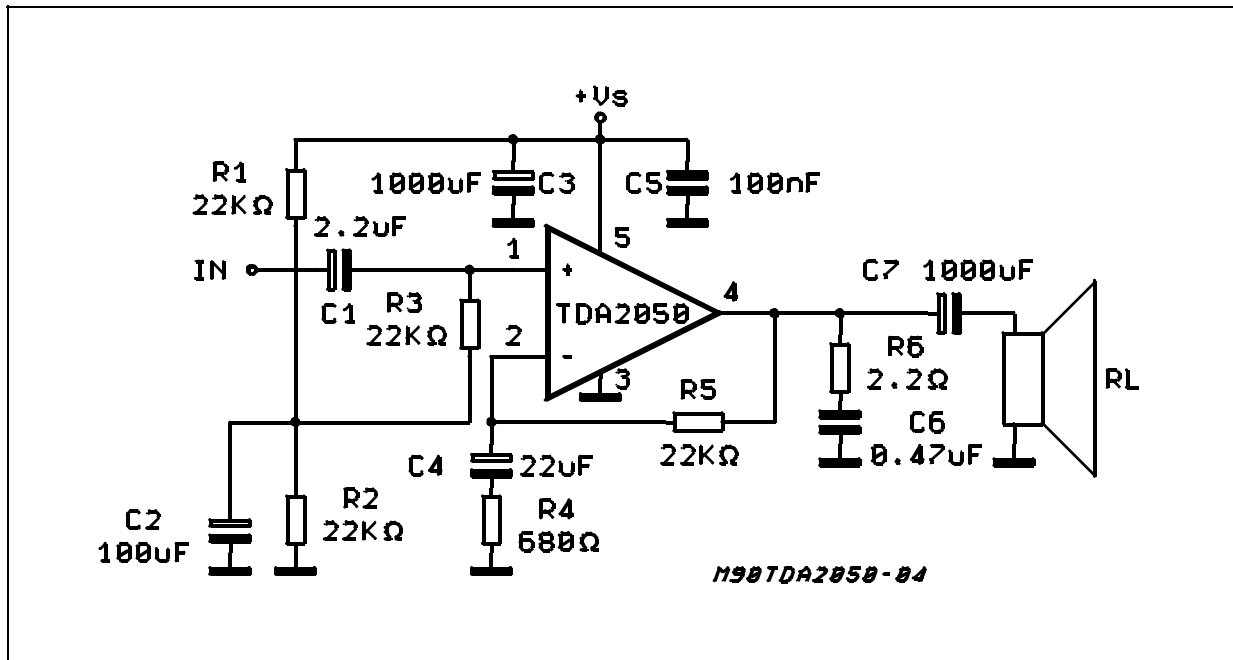
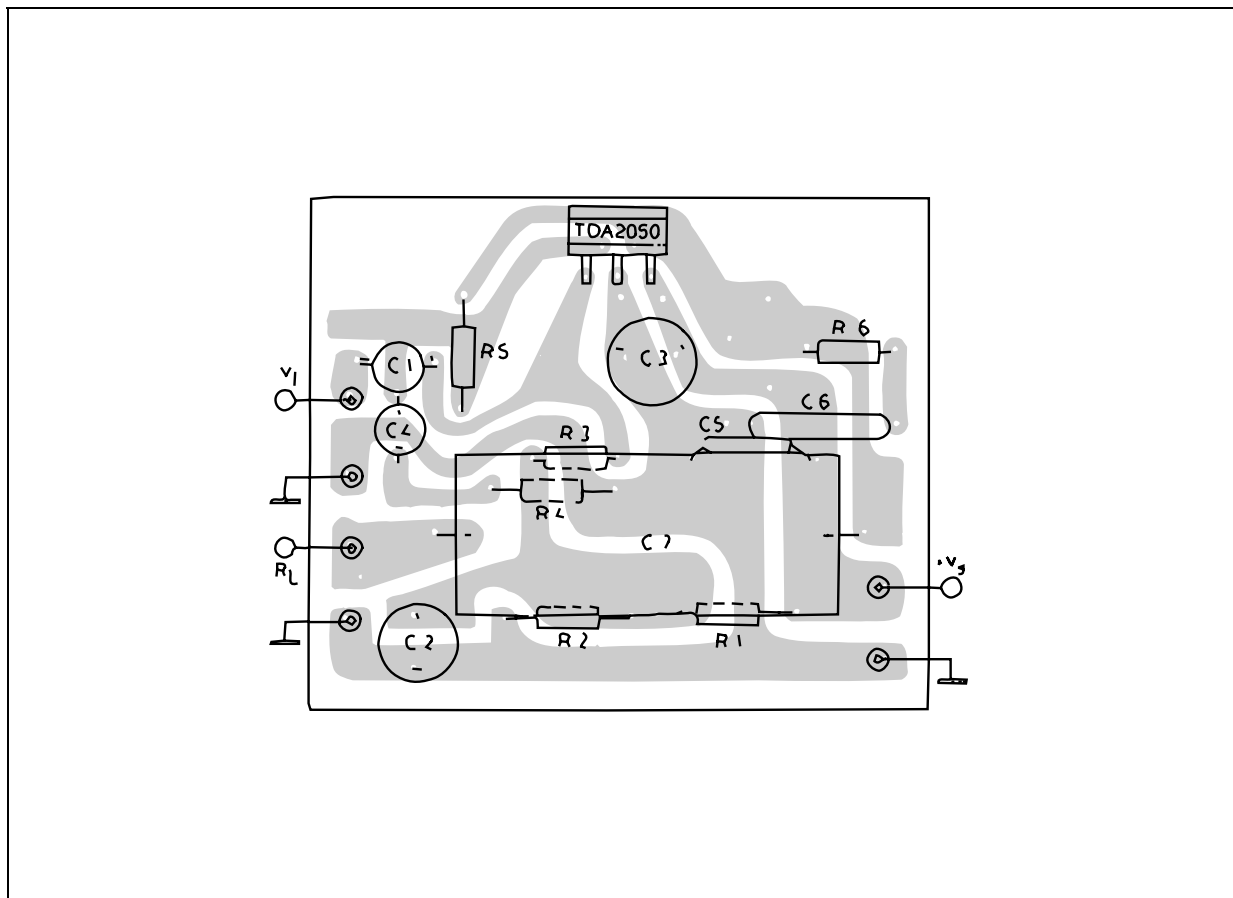


Figure 4: P.C. Board and Components Layout of the Circuit of Fig. 3 (1:1)



SINGLE SUPPLY APPLICATION SUGGESTIONS

The recommended values of the external components are those shown on the application circuit

of fig. 3. Different values can be used. The following table can help the designer.

| Component | Recommended Value | Purpose | Larger than Recommended Value | Smaller than Recommended Value |
|------------|-------------------|-------------------------------|---|---|
| R1, R2, R3 | 22kΩ | Biasing Resistor | | |
| R4 | 680Ω | Feedback Resistors | Increase of Gain | Decrease of Gain (*) |
| R5 | 22kΩ | | Decrease of Gain (*) | Increase of Gain |
| R6 | 2.2Ω | Frequency Stability | Danger of Oscillations | |
| C1 | 2.2μF | Input Decoupling DC | | Higher Low-frequency cut-off |
| C2 | 100μF | Supply Voltage Rejection | Worse Turn-off Transient Worse Turn-on Delay | |
| C3 | 1000μF | Supply Voltage Bypass | | Danger of Oscillations Worse of Turn-off Transient |
| C4 | 22μF | Inverting Input DC Decoupling | Increase of Switching ON/OFF | Higher Low-frequency cut-off |
| C5 | 100nF | Supply Voltage Bypass | | Danger of Oscillations |
| C6 | 0.47μF | Frequency Stability | | Danger of Oscillations |
| C7 | 1000μF | Output DC Decoupling | | Higher Low-frequency cut-off |

(*) The gain must be higher than 24dB

NOTE

If the supply voltage is lower than 40V and the load is 8ohm (or more) a lower value of C2 can

be used (i.e. 22μF).
C7 can be larger than 1000uF only if the supply voltage does not exceed 40V.

TYPICAL CHARACTERISTICS (Split Supply Test Circuit unless otherwise specified)

Figure 5: Output Power vs. Supply Voltage

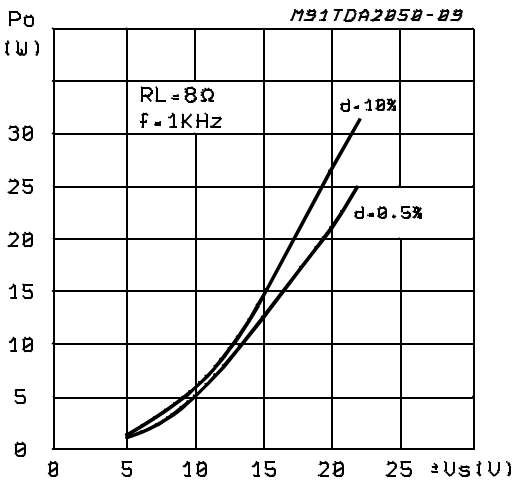


Figure 6: Distortion vs. Output Power

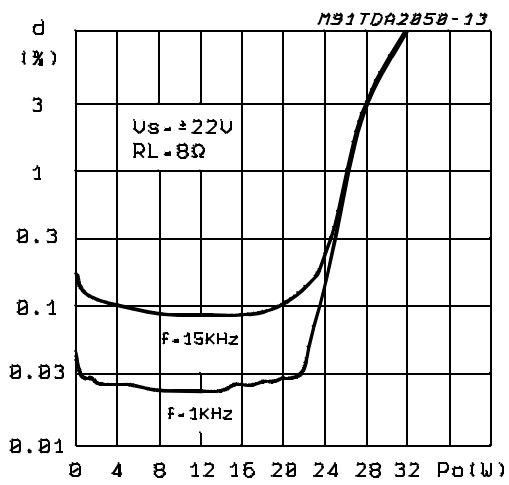


Figure 7: Output Power vs. Supply Voltage

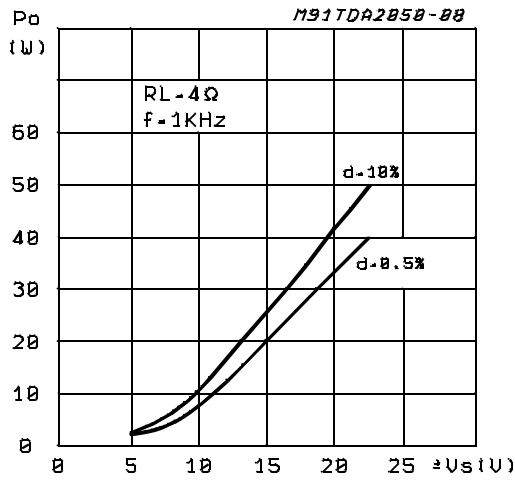


Figure 9: Distortion vs. Frequency

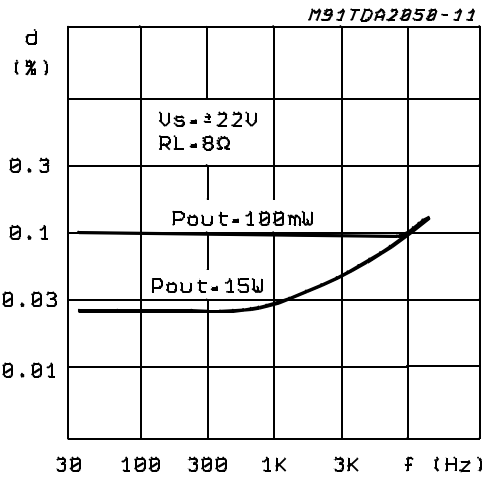


Figure 11: Quiescent Current vs. Supply Voltage

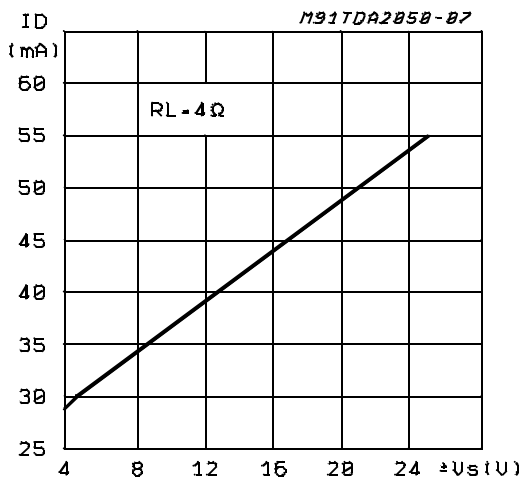


Figure 8: Distortion vs. Output Power

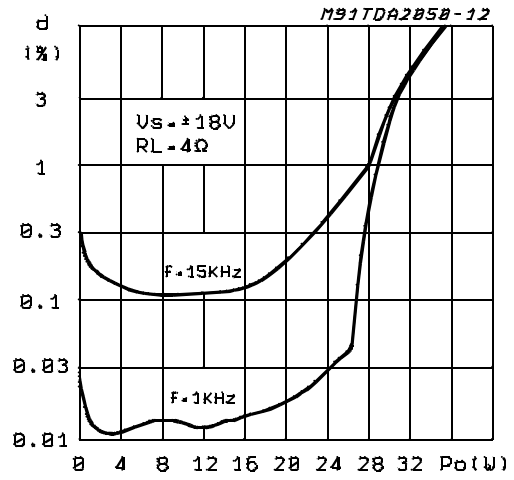


Figure 10: Distortion vs. Frequency

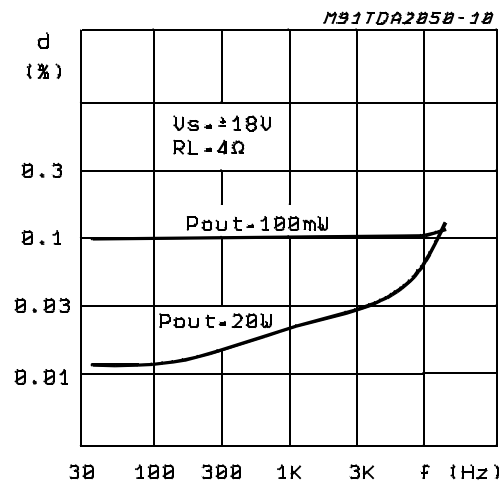


Figure 12: Supply Voltage Rejection vs. Frequency

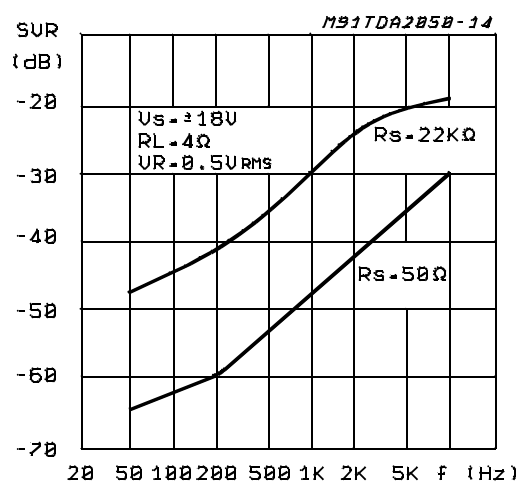


Figure 13: Supply Voltage Rejection vs. Frequency (Single supply) for Different values of C2 (circuit of fig. 3)

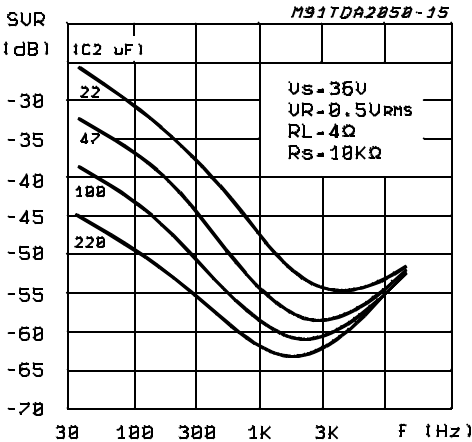


Figure 14: Supply Voltage Rejection vs. Frequency (Single supply) for Different values of C2 (circuit of fig. 3)

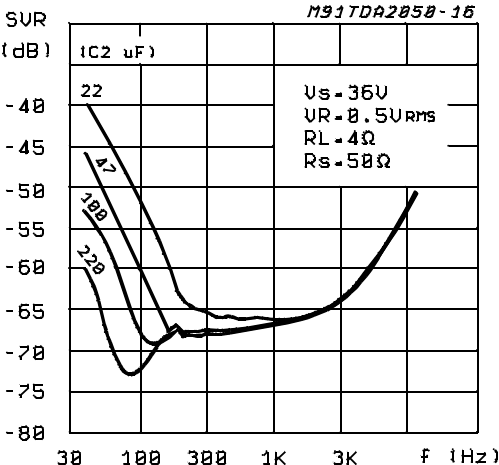


Figure 15: Total Power Dissipation and Efficiency vs. Output Power

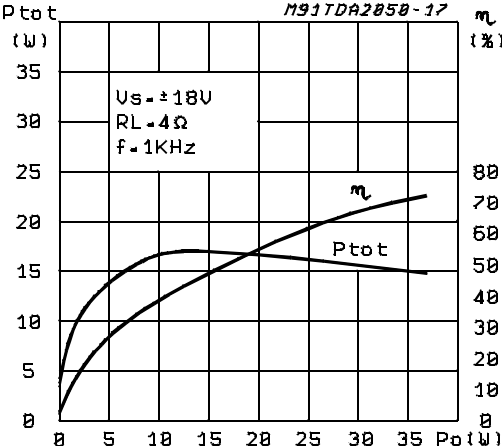
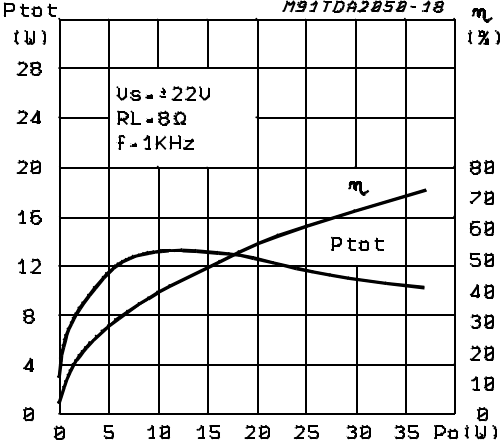


Figure 16: Total Power Dissipation and Efficiency vs. Output Power



SHORT CIRCUIT PROTECTION

The TDA 2050 has an original circuit which limits the current of the output transistors. The maximum output current is a function of the collector emitter voltage; hence the output transistors work within their safe operating area. 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 SHUTDOWN

The presence of a thermal limiting circuit offers the following advantages:

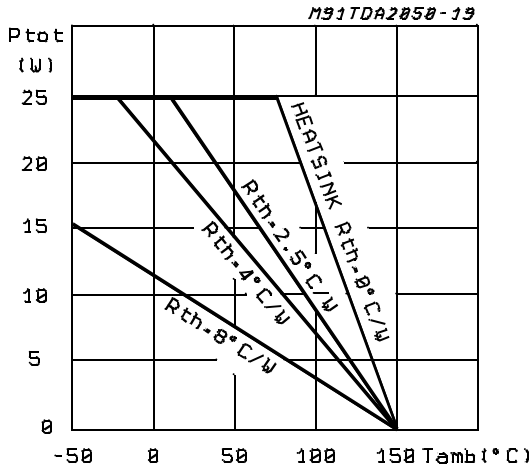
- 1) An overload on the output (even if it is permanent), or an above limit ambient temperature can be easily tolerated since the T_j cannot be higher than $150^\circ C$.
- 2) The heatsink can have a smaller factor of safety compared with that of a conventional circuit. There is no possibility of device damage due to high junction temperature. If for any reason, the junction temperature increases up to $150^\circ C$, the thermal shutdown simply reduces the power dissipation and the current consumption.

The maximum allowable power dissipation depends upon the thermal resistance junction-ambi-



ent. Fig. 17 shows this dissipable power as a function of ambient temperature for different thermal resistance.

Figure 17: Maximum Allowable Power Dissipation vs. Ambient Temperature



MOUNTING INSTRUCTIONS

The power dissipated in the circuit must be removed by adding an external heatsink.

Thanks to the PENTAWATT package, the heatsink mounting operation is very simple, a screw or a compression spring (clip) being suffi-

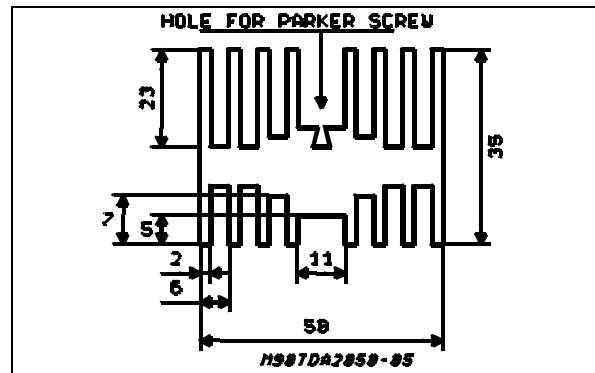
cient. Between the heatsink and the package is better to insert a layer of silicon grease, to optimize the thermal contact; no electrical isolation is needed between the two surfaces. Fig. 18 shows an example of heatsink.

Dimension suggestion

The following table shows the length that the heatsink in fig. 18 must have for several values of Ptot and Rth.

| | | | |
|------------------------------------|-----|-----|-----|
| P _{tot} (W) | 12 | 8 | 6 |
| Length of heatsink (mm) | 60 | 40 | 30 |
| R _{th} of heatsink (°C/W) | 4.2 | 6.2 | 8.3 |

Figure 18: Example of heat-sink



APPENDIX A

A.1 - MUSIC POWER CONCEPT

MUSIC POWER is (according to the IEC clauses n.268-3 of Jan 83) the maximum power which the amplifier is capable of producing across the rated load resistance (regardless of non linearity) 1 sec after the application of a sinusoidal input signal of frequency 1 KHz.

According to this definition our method of measurement comprises the following steps:

- Set the voltage supply at the maximum operating value;
- Apply a input signal in the form of a 1KHz tone burst of 1 sec duration: the repetition period of the signal pulses is 60 sec;
- The output voltage is measured 1 sec from the start of the pulse;
- Increase the input voltage until the output signal shows a THD=10%;
- The music power is then V_{out}^2 / RL , where V_{out} is the output voltage measured in the condition of point 4 and RL is the rated load impedance;

The target of this method is to avoid excessive dissipation in the amplifier.

A.2 - INSTANTANEOUS POWER

Another power measurement (MAXIMUM INSTANTANEOUS OUTPUT POWER) was proposed by IEC in 1988 (IEC publication 268-3 sub-clause 19.A).

We give here only a brief extract of the concept, and a circuit useful for the measurement.

The supply voltage is set at the maximum operating value.

The test signal consists of a sinusoidal signal whose frequency is 20 Hz, to which are added alternate positive and negative pulses of 50 μs duration and 500 Hz repetition rate. The amplitude of the 20 Hz signal is chosen to drive the amplifier to its voltage clipping limits, while the amplitude of the pulses takes the amplifier alternately into its current-overload limits.

A circuit for generating the test signal is given in fig. 19.

The load network consists of a 40 μF capacitor, in series with a 1 ohm resistor. The capacitor limits the current due to the 20 Hz signal to a low value, whereas for the short pulses the effective load impedance is of the order of 1 ohm, and a high output current is produced.

Using this signal and load network the measurement may be made without causing excessive dissipation in the amplifier. The dissipation in the 1 ohm resistor is much lower than a rated output

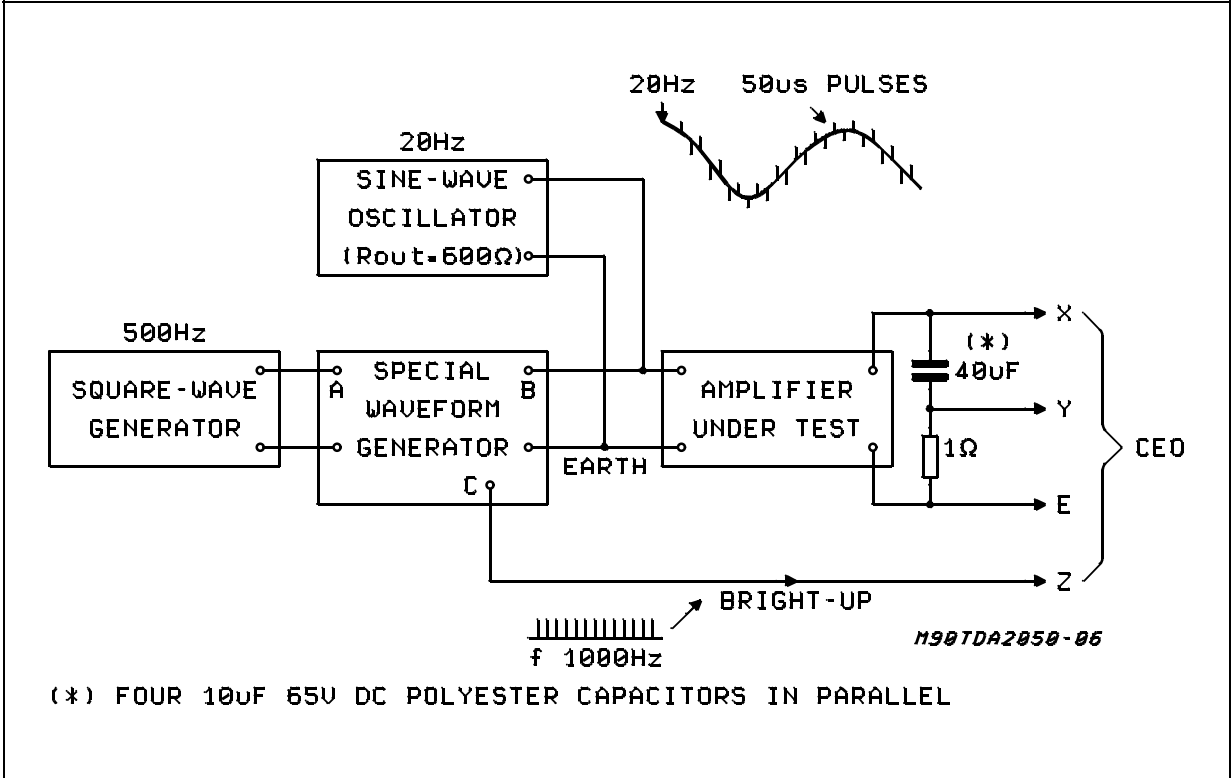
power of the amplifier, because the duty-cycle of the high output current is low.

By feeding the amplifier output voltage to the X-plates of an oscilloscope, and the voltage across the 1 ohm resistor (representing the output current) to the Y-plates, it is possible to read on the display the value of the maximum instantaneous output power.

The result of this test applied at the TDA 2050 is:

PEAK POWER = 100W typ

Figure 19: Test circuit for peak power measurement



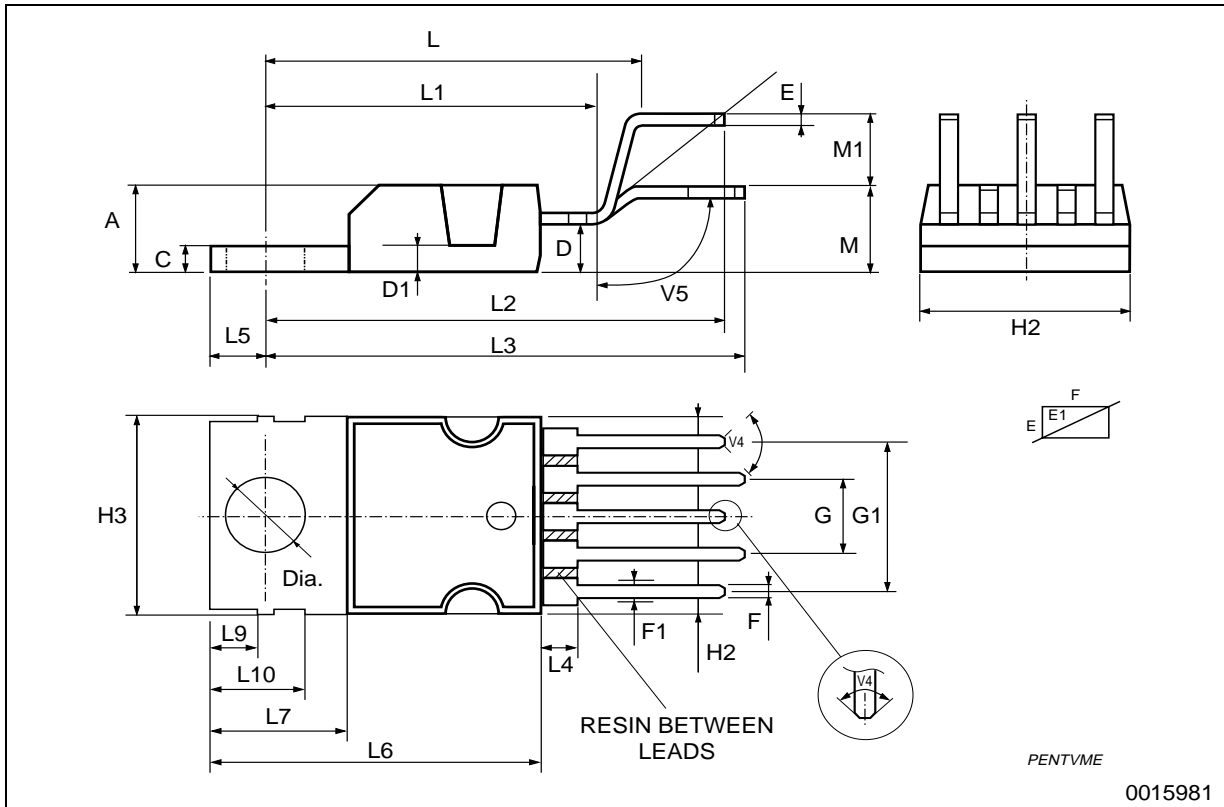
| DIM. | mm | | | inch | | |
|------|------------|-------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 4.8 | | | 0.189 |
| C | | | 1.37 | | | 0.054 |
| D | 2.4 | | 2.8 | 0.094 | | 0.110 |
| D1 | 1.2 | | 1.35 | 0.047 | | 0.053 |
| E | 0.35 | | 0.55 | 0.014 | | 0.022 |
| E1 | 0.76 | | 1.19 | 0.030 | | 0.047 |
| F | 0.8 | | 1.05 | 0.031 | | 0.041 |
| F1 | 1.0 | | 1.4 | 0.039 | | 0.055 |
| G | 3.2 | 3.4 | 3.6 | 0.126 | 0.134 | 0.142 |
| G1 | 6.6 | 6.8 | 7.0 | 0.260 | 0.268 | 0.276 |
| H2 | | | 10.4 | | | 0.409 |
| H3 | 10.05 | | 10.4 | 0.396 | | 0.409 |
| L | 17.55 | 17.85 | 18.15 | 0.691 | 0.703 | 0.715 |
| L1 | 15.55 | 15.75 | 15.95 | 0.612 | 0.620 | 0.628 |
| L2 | 21.2 | 21.4 | 21.6 | 0.831 | 0.843 | 0.850 |
| L3 | 22.3 | 22.5 | 22.7 | 0.878 | 0.886 | 0.894 |
| L4 | | | 1.29 | | | 0.051 |
| L5 | 2.6 | | 3.0 | 0.102 | | 0.118 |
| L6 | 15.1 | | 15.8 | 0.594 | | 0.622 |
| L7 | 6.0 | | 6.6 | 0.236 | | 0.260 |
| L9 | 2.1 | | 2.7 | 0.008 | | 0.106 |
| L10 | 4.3 | | 4.8 | 0.17 | | 0.189 |
| M | 4.23 | 4.5 | 4.75 | 0.167 | 0.178 | 0.187 |
| M1 | 3.75 | 4.0 | 4.25 | 0.148 | 0.157 | 0.167 |
| V4 | 40° (typ.) | | | | | |
| V5 | 90° (typ.) | | | | | |
| Dia | 3.65 | | 3.85 | 0.144 | | 0.152 |

OUTLINE AND MECHANICAL DATA

Weight: 2.00gr



Pentawatt V



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