

# Technical Note

## Heat Sink Selection for TO220-50W Power Film Resistor

### 1. DC operation and heat-sink selection

In DC and low frequency AC operation, rating power of resistor shall be limited as shown in derating curve of figure 1.

In case of a resistor, TO-220 rated power of 50W and in 10W operation, Figure 1 shows availability of 130 deg C flange temperature operation in worst case.

When the resistor and heat-sink operate in ambient temperature of 50 deg C, thermal resistance ( $R_t$ ) of the heat-sink will be calculated by;

$$R_t = \frac{130 - 50}{10} = 8.0 \text{ (K/W)}$$

We are looking for 8 K/W standard heat-sink, on board style, in catalogue of a heat-sink supplier, we will find as shown in figure 2 typical. 54x50x15mm heat-sink has performance of 6.58K/W.

When we obtain a 6.58K/W heat sink, we will check operation flange temperature ( $T_f$ ) at 10W application again as following;

$$T_f = (6.58 \times 10) + 50$$

$$T_f = 115.8 \text{ deg C}$$

### 2. Metal panel heat-sink

In case of using metal plate heat-sink installed vertically on circuit board as shown in figure 6, we can obtain area of metal plate from figure 3 as 10,000mm square for 7K/W thermal resistance.

### 3. Direct attach on circuit board

TO220 resistor can be attached on circuit board as shown in figure 4. Heat generated from resistor will be transferred through circuit board material.

Thermal resistance will be estimated as figure 5 from actual measurement. Please note that another parts and soldering joint will be applied of heat.

### 4. Independent installation

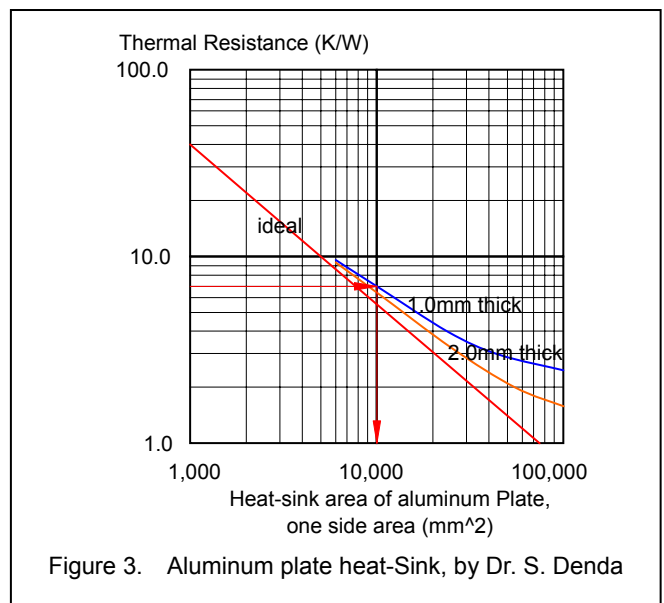
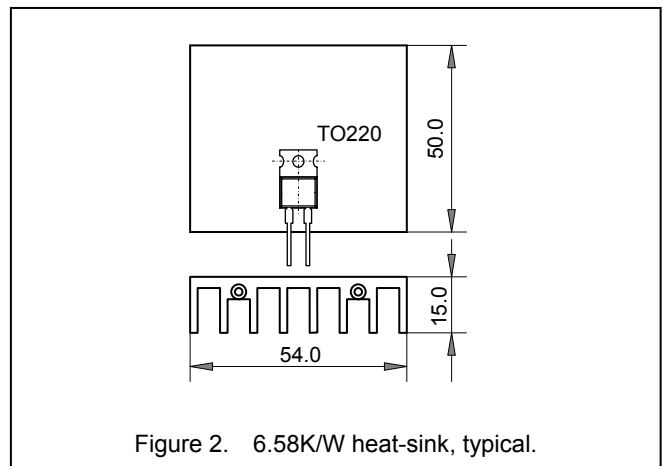
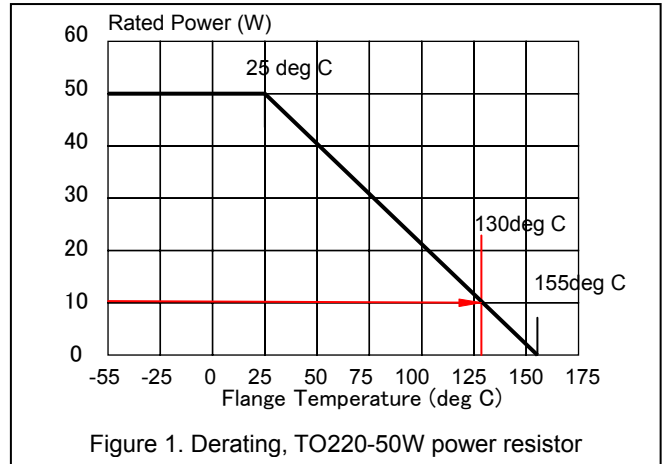
When resistor mount on circuit board without heat-sink as shown figure 7, heating will be diffused from surface of resistor and thermal resistance will be estimated as 58K/W at 1W application.

### 5. Typical installation

Please find figure 8 and figure 9.

### 6. Note

In the upper calculation, the limit of available power or permissive temperature is explained on account of explanation. In actual design, consideration for safety factor and power derating may be recommended.



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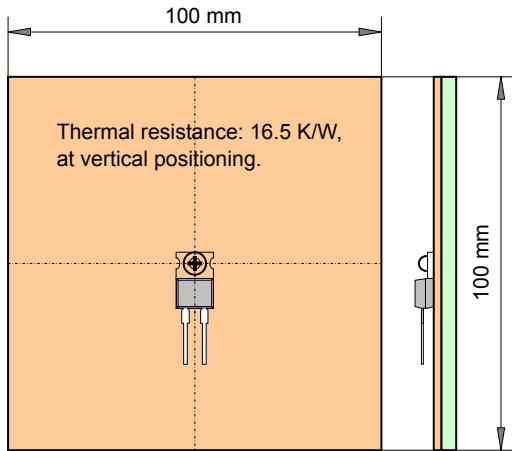


Figure 4. Heat diffusion thru phenol-paper circuit board, 1.6mm thickness, 35um Cu on one-side

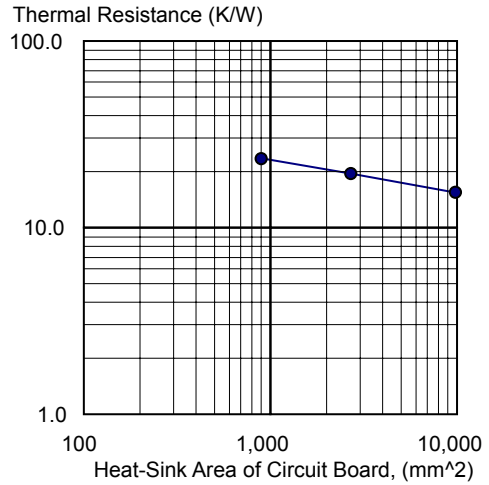


Figure 5. Thermal resistance, circuit board  
23.5K/W(30mmx30mm), 20K/W(50mmx50mm), 16.5K/W(100mmx100mm)

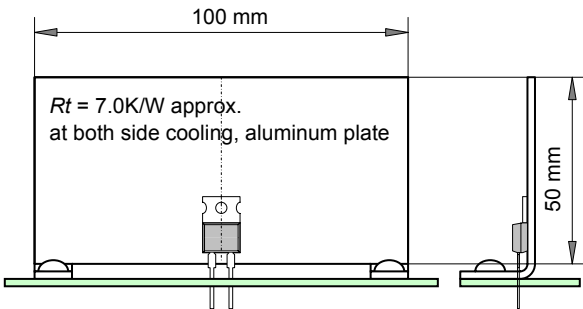


Figure 6. Thermal resistance of vertical aluminum plate heat-sink, 100mmx50mm is 7K/W approximately.

Thermal resistance: about 58 K/W,  
Temperature rise at flange 58 deg C/1W  
110 deg C/2W

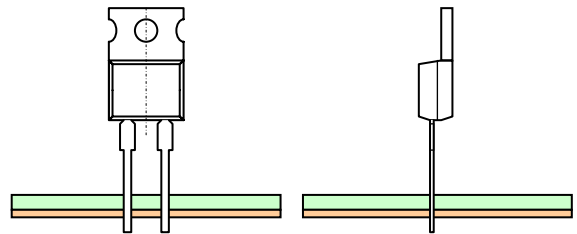


Figure 7. Isolated installation, TO220. Heat conduction thru terminal is ignored.

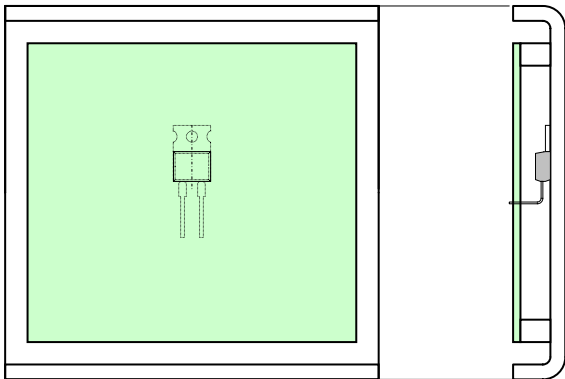


Figure 8. Typical installation. Flanged resistor is mounted on case or chassis behind of circuit board. Please note that chassis temperature will go over 100 deg C under operation.

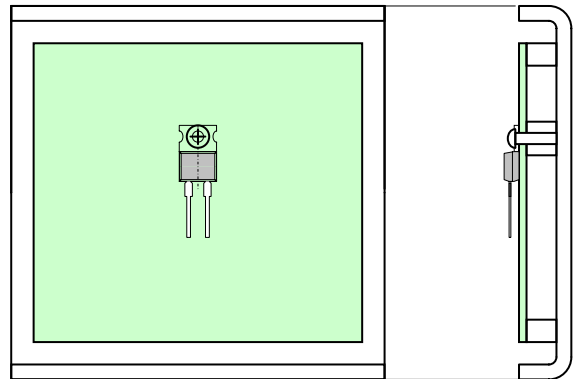


Figure 9. Typical installation. Flanged resistor is mounted on circuit board and resistor heating will transfer to case or chassis thru a screw.