Assembly Instructions

General

Semiconductor devices can be mounted in any position. The terminal length may be bent at a distance greater than 1.5 mm from the case provided no mechanical force has an effect on the case.

If the device is to be mounted near heat generating components, consideration must be given to the resultant increase in ambient temperature.

Soldering Instructions

Leaded Devices

Protection against overheating is essential when a device is being soldered. It is recommended, therefore, that connection terminals are left as long as possible, are soldered at the tip only, and that any heat generated is quickly conducted away. The time during which the specified maximum permissible device junction temperature is exceeded during the soldering operation should be as short as possible, (i.e., for silicon, 260 °C for 5 seconds.

Avoid any force on the body or leads during or just after soldering.

Do not correct the position of an already soldered device by pushing, pulling or twisting the body. Prevent fast cooling after soldering.

The maximum soldering temperatures are shown in table 1.

	Iron Soldering			Dip or Flow Soldering			
	Iron Temperature	Soldering Distance from the Case	Maximum Allowable Soldering Time	Soldering Temperature	Soldering Distance from the Case		Maximum Allowable Soldering Time
					Vertical	Horizontal	
Glass case	≤ 260 °C	1.5 to 5 mm	5 s	≤ 260 °C	> 1.5 mm	> 5 mm	5 s
	≤ 260 °C	> 5 mm	10 s				
	260 to 400 °C	> 5 mm	5 s				
Plastic case	≤ 260 °C	2 to 5 mm	3 s	≤ 260 °C	> 1.5 mm	> 5 mm	3 s
	≤ 260 °C	> 5 mm	5 s				
23 A 3 DIN41869 (SOT23)	≤ 250 °C	–	10 s	≤ 250 °C	–	–	10 s

Table 1: Maximum soldering temperatures

Surface Mounted Devices

Surface mounted devices (SMD) are components which are mounted directly on the surface of a printed circuit board without having to drill holes. In addition, these components can be completely submerged in solder bath (overhead soldering). The SMD technology offers the following main advantages:

- Higher packing density (miniaturization)
- Reduction of the component mounting costs fully automatic mounting

a) Gluing

In the case of flow or drag soldering, the components must be glued to the printed circuit board. The adhesive used for this purpose must be electrically neutral and must not react chemically with the materials of the printed circuit board or the components. The adhesive must not negatively affect subsequent soldering. After mounting, the adhesive must be hardened. The ultraviolet and/or thermal radiation commonly used for hardening is uncritical for our components. In the case of other soldering methods, gluing can be omitted if the flux or the solder paste provides sufficient adhesion of the components to the printed circuit board.

b) Soldering

The pins of Vishay components are already tinned.

Dip soldering, flow soldering, reflow soldering, and vapor phase soldering are permissible.

The maximum temperature of 260 °C over a period 5 s must not be exceeded during soldering.

No aggressive fluxes may be used.

A soldering iron should be used only in exceptional cases (repairs, etc.). A temperature regulated miniature soldering iron must be used, and care should be taken to avoid touching the component with the tip of the soldering iron.

For optoelectronic semiconductor components, the maximum soldering temperature is 240 °C for 5 s.

c) Cooling

Cooling of the components with a fan after soldering is permissible.

d) Cleaning

If cleaning is necessary after soldering, it is recommended to wash with water which contains a detergent free of deposits.

Important layout notes

If components are to be arranged in rows, then separate soldering surfaces must be provided for each component. If this is not carried out, a block of solder forms between the components during soldering, and a rigid connection result. This can cause breakage or cracks in the component as the result of the slightest bending of the board, and thus lead to failures. If it is necessary to solder a wire (standard conductor, etc.) to the board, a separate soldering surface must be provided in order to avoid excessive heating of the components during soldering with a soldering iron.

Heat Removal

To keep the thermal equilibrium, the heat generated in the semiconductor junction(s) must be removed. In the case of low-power devices, the natural heat conductive path between the case and surrounding air is usually adequate for this purpose. However, in the case of medium-power devices, heat radiation may have to be improved by the use of star- or flag-shaped heat dissipaters, which increase the heat radiating surface.

Finally, in the case of high-power devices, special heat sinks must be provided, the cooling effect of which can be increased further by the use of special coolants or air blowers.

The heat generated in the junction is conveyed to the case or header by conduction rather than convection. A measure of the effectiveness of heat conduction is the inner thermal resistance or thermal resistance junction case, R_{thJC}, the value of which is governed by the construction of the device.

Any heat transfer from the case to the surrounding air involves radiation convection and conduction. The effectiveness of transfer is expressed in terms of an R_{thCA}-value, i.e., the external or case-ambient thermal resistance. The total thermal resistance between junction and ambient is consequently

$$R_{thJA} = R_{thJC} + R_{thCA}.$$

The total maximum power, $P_{tot\ max}$, of a semiconductor device can be expressed as follows

$$P_{\text{tot max}} = \frac{T_{jmax} - T_{amb}}{R_{thJA}} = \frac{T_{max} - T_{amb}}{R_{thJA} + R_{thCA}}$$

where

T_{jmax} is the maximum junction temperature,

T_{amb} is the highest ambient temperature likely to be reached under the most unfavorable conditions,

R_{thJA} is the thermal resistance between junction and ambient. For diodes with axial leads, it is measured with a heat sink at a specified distance from the case,

R_{thJC} is the thermal resistance between junction and case,

R_{thCA} is the thermal resistance between case and ambient.

Its value is cooling dependent. When using a heat sink, it can be influenced through thermal contact between the case and heat sink, thermal distribution in the heat sink and heat transfer to the surroundings.

Therefore, the maximum permissible total power dissipation for a given semiconductor device can be influenced only by changing T_{amb} and R_{thCA}. The value of R_{thCA} can be obtained either from the data of heat sink suppliers or through direct measurements.

Heat due to energy losses is mainly conducted with power diodes without cooling pins through the connecting leads and hence the pc board.

Figure 1 shows the thermal resistance plotted as a function of edge length. The values are valid with a heat source in the middle of the plate, resting air and vertical position. With horizontal position, thermal resistance increases approximately by 15 to 20 %.

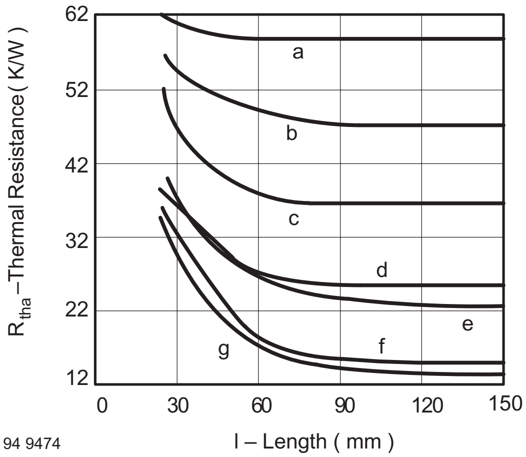

Figure 1.

Pertinax boards 1.5 mm thick

a: Pertinax non-metallized

b: Pertinax with 35 mm copper metallization on one side; heat source fitted to non-metallized side

c: Pertinax with 70 mm copper metallization on one side; heat source fitted to non-metallized side

d: Pertinax with 35 mm copper metallization on one side; heat source fitted to metallized side

e: Pertinax with 35 mm copper metallization on both sides

f: Pertinax with 70 mm copper metallization on one side; heat source fitted to metallized side

g: Pertinax with 70 mm copper metallization on both sides

R_{tha}: Thermal resistance of boards

l: Edge length

When using cooling plates as heat sinks without optimum performance, the following approach is acceptable.

The curves shown in figures 2 and 3 are given for thermal resistance, R_{thCA}, by using square plates of aluminium with edge length **a** but with different thicknesses.

The device case should be mounted directly on the cooling plate.

The edge length **a** derived from figures 2 and 3 for a given R_{thCA} value must be multiplied with α and β:

$a' = a \times \beta \times \alpha$

where

α = 1.00 for vertical arrangement

α = 1.15 for horizontal arrangement

β = 1.00 for bright surface

β = 0.85 for dull black surface

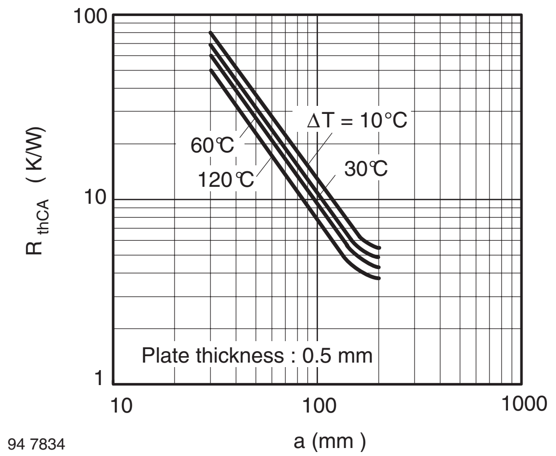

Figure 2.

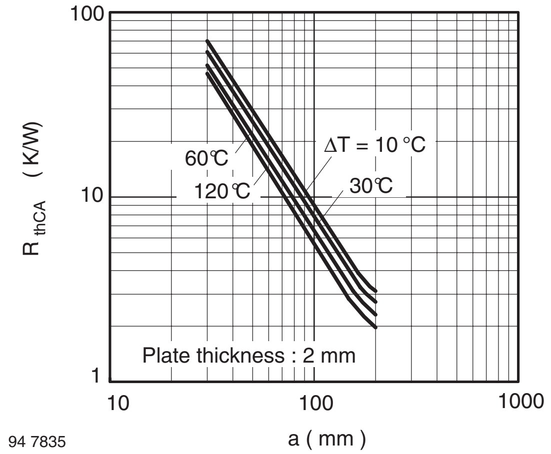

Figure 3.