DATA SHEET

Mounting

Chip Resistors

Supersedes data of 11th February 1999

2001 May 30 Rev.2

MOUNTING

Due to their rectangular shape and small dimensional tolerances, Surface Mounted Resistors are suitable for handling by automatic placement systems. Chip placement can be on ceramic substrates and printed-circuit boards (PCBs). Electrical connection to the circuit is by wave, vapour phase or infrared soldering. The end terminations guarantee a reliable contact and the protective coating enables 'face down' mounting.

The temperature rise in a resistor due to power dissipation, is determined by the laws of heat - conduction, convection and radiation. The maximum body temperature usually occurs in the middle of the resistor and is called the **hot-spot** temperature.

The hot-spot temperature depends on the ambient temperature and the dissipated power. This is described in the data sheets under the chapter heading "Functional description".

The hot-spot temperature is important for mounting because the connections to the chip resistors will reach a temperature close to the hot-spot temperature. Heat conducted by the connections must not reach the melting point of the solder at the joints. Therefore a maximum solder joint temperature of 110 °C is advised.

The ambient temperature on large or very dense printed-circuit boards (PCBs) is influenced by the dissipated power. The ambient temperature will again influence the hot-spot temperature. Therefore, the packing density that is allowed on the PCB is influenced by the dissipated power.

Example of mounting effects

Assume that the maximum temperature of a PCB is 95 °C and the ambient temperature is 50 °C. In this case the maximum temperature rise that may be allowed is 45 °C. In the graph (see Fig.1), this point is found by drawing the line from point A (PCB = 95 °C) to point B (T_{amb} = 50 °C) and from here to the left axis.

To find the maximum packing density, this horizontal line is extended until it intersects with the curve, 0.125 W (point C). The maximum packing density, 19 units/50 × 50 mm^2 (point D), is found on the horizontal axis.

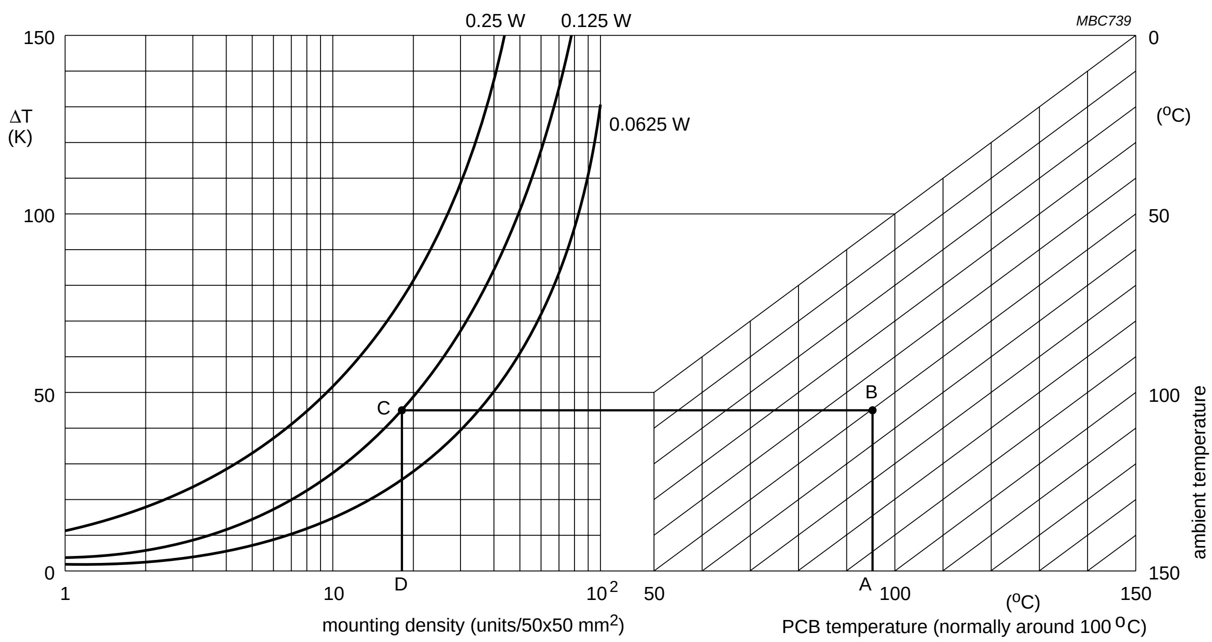


Fig.1 PCB temperature as a function of applied power, mounting density and ambient temperature.

Thermal resistance (R_{th})

Thermal resistance prohibits the release of heat generated within the resistor to the surrounding environment. It is expressed in K/W and defines the surface temperature (T_{HS}) of the resistor in relation to the ambient temperature (T_{amb}) and the load (P) of the resistor, as follows:

$T_{HS} = T_{amb} + P \times R_{th}$

Due to their direct contact with the solder spot, chip resistors dissipate over 85% of their heat via conduction to the solder spot and hence to the PCB. Thus the PCB on which the chip resistor is mounted functions as a heat sink. Different PCBs have different heat conductance. Figure 2 shows the different values of heat resistance per material type. Substrates with a higher heat conductance give lower thermal resistance figures; substrates with a lower heat conductance give higher thermal resistance figures.

It should be noted that the temperature of the terminations of the chip resistor is virtually the same as the hot-spot temperature. Therefore the power that may be dissipated by the resistor is dependent on:

T_{amb} (which is also dependent on the packing density)

R_{th} of the PCB

maximum solder spot temperature (generally 110 °C).

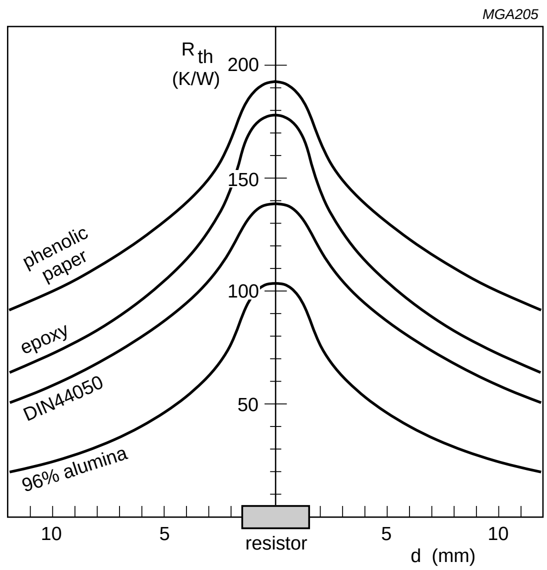
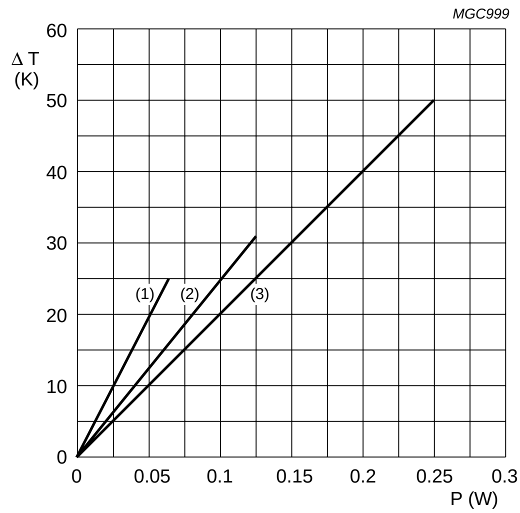


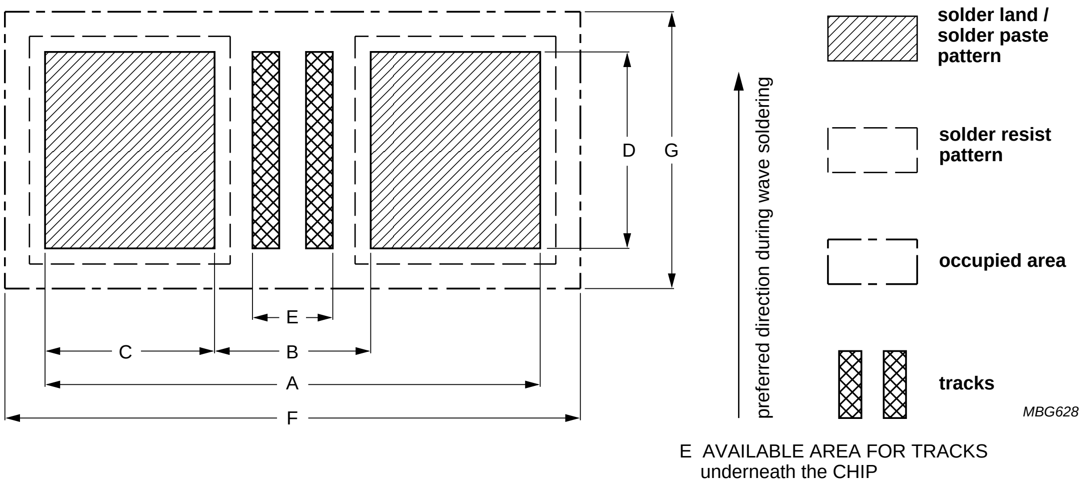
Fig.2 Heat resistance for 1206 sized resistors as a function of distance and material.



(1) For size 0603: R_{th} = 400 K/W.
(2) For size 0805: R_{th} = 250 K/W.
(3) For size 1206: R_{th} = 200 K/W.

Fig.3 Hot-spot temperature rise (ΔT) as a function of dissipated power.

FOOTPRINT DIMENSIONS



For dimensions see Tables 1 and 2.

Fig.4 Recommended dimensions of footprints.

Table 1 Reflow soldering; for dimensions see also Fig.4

SIZE CODE	FOOTPRINT DIMENSIONS (mm)							PROCESSING REMARKS	PLACEMENT ACCURACY (mm)
	A	B	C	D	E	F	G		
0402	1.5	0.5	0.5	0.6	0.1	1.9	1.0	IR or hot plate soldering	±0.15
0603	2.1	0.5	0.8	0.9	0.0	2.5	1.7		±0.25
0805	2.6	0.9	0.85	1.4	0.5	3.0	2.1		±0.25
1206	3.8	2.0	0.9	1.8	1.4	4.2	2.5		±0.25
1218	3.8	2.0	0.9	1.8	1.4	4.2	2.5		±0.25
2010	5.6	3.8	0.9	2.8	3.4	5.85	3.15		±0.25
2512	7.0	3.8	1.6	3.5	3.4	7.25	3.85		±0.25

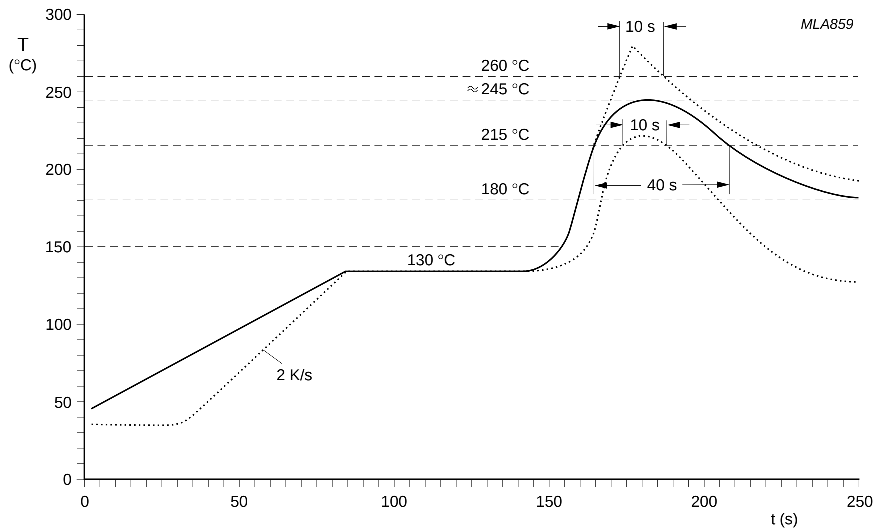
Table 2 Wave soldering (no dummy tracks allowed for the high voltage series); for dimensions see also Fig.4

SIZE CODE	FOOTPRINT DIMENSIONS (mm)							PROPOSED NUMBER AND DIMENSIONS OF DUMMY TRACKS (mm)	PLACEMENT ACCURACY (mm)
	A	B	C	D	E	F	G		
0603	2.7	0.9	0.9	0.8	0.15	3.2	1.9	$1 \times (0.15 \times 0.8)$	±0.25
0805	3.3	1.3	1.0	1.3	0.34	3.9	2.4	$1 \times (0.3 \times 1.3)$	±0.25
1206	4.5	2.5	1.0	1.7	1.25	3.9	2.4	$3 \times (0.25 \times 1.7)$	±0.25
1218	4.5	2.5	1.0	1.7	1.25	4.6	3.6	–	±0.25
2010	6.3	4.3	1.0	2.5	3.00	7.0	3.6	–	±0.25
2512	7.7	5.7	1.0	3.2	3.00	8.4	4.3	–	±0.25

SOLDERING CONDITIONS

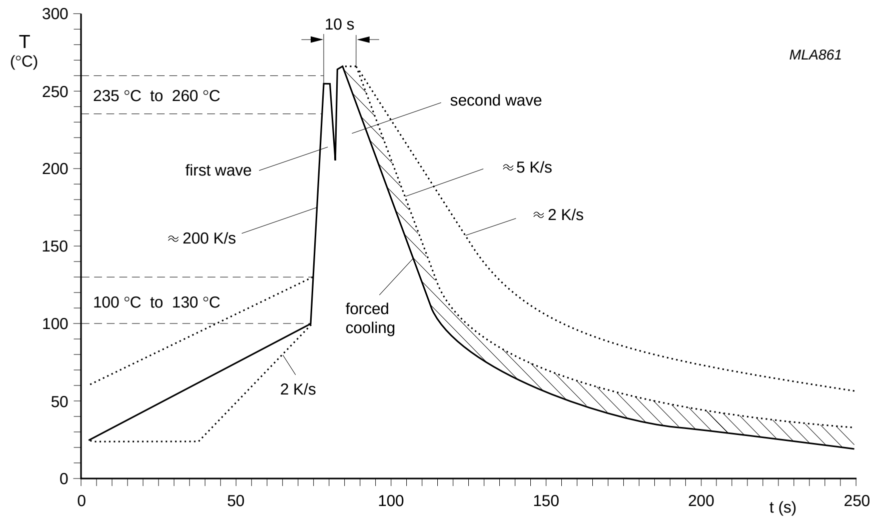
The robust construction of chip resistors allows them to be completely immersed in a solder bath of 260 °C for one minute. Therefore, it is possible to mount Surface Mount Resistors on one side of a PCB and other discrete components on the reverse (mixed PCBs).

Surface Mount Resistors are tested for solderability at 235 °C during 2 seconds. The test condition for no leaching is 260 °C for 60 seconds. Typical examples of soldering processes that provide reliable joints without any damage, are given in Figs 5, 6 and 7.



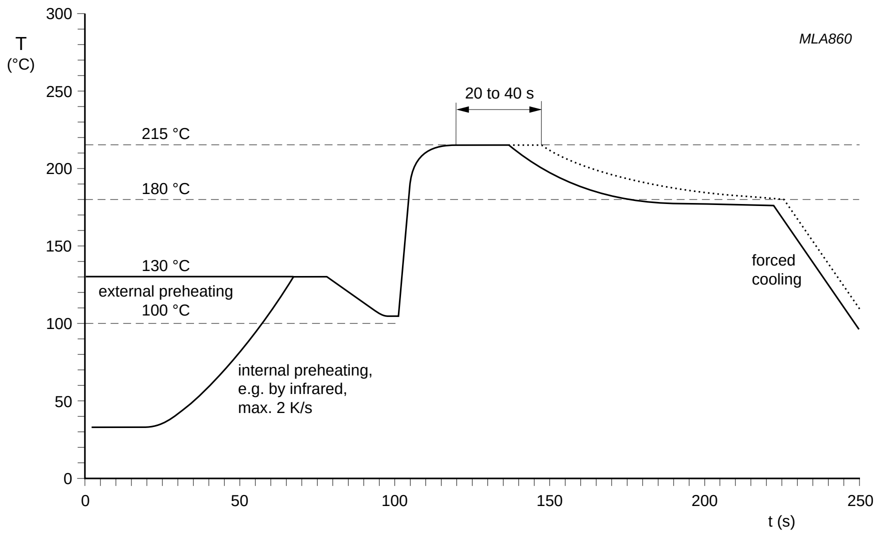
Typical values (solid line).
Process limits (dotted lines).

Fig.5 Infrared soldering.



Typical values (solid line).
Process limits (dotted lines).
The resistors may be soldered twice in accordance with this method if desired.

Fig.6 Double wave soldering.



Typical values (solid line).
Process limits (dotted line).

Fig.7 Vapour phase soldering.

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REVISION HISTORY

Revision	Date	Change Notification	Description
Rev.2	2001 May 30	–	- Converted to Phycomp brand