Innovative Service Around the Globe YAGEO

DATA SHEET

CHIP RESISTORS

Mounting

YAGEO Phycomp

Product Specification – February 13, 2018 V.10

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 laws of heat conduction, convection and radiation determine the temperature rise in a resistor owing to power dissipation. 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 mm2 (point D), is found on the horizontal axis

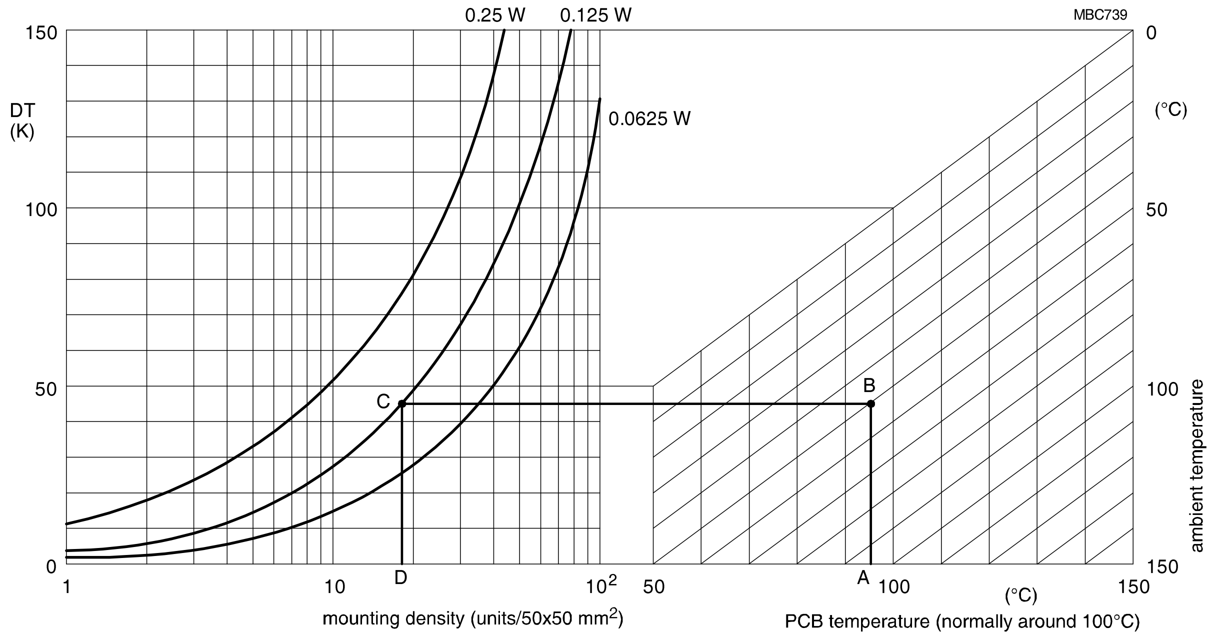


Fig. 1 PCB temperature as a function of applied power, mounting density and ambient temperature

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).

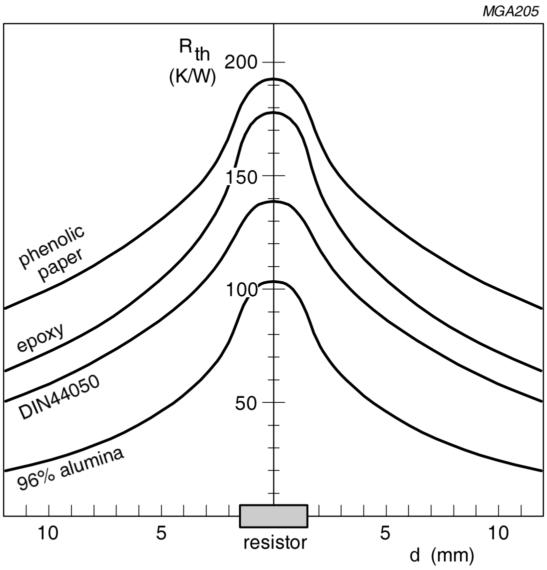
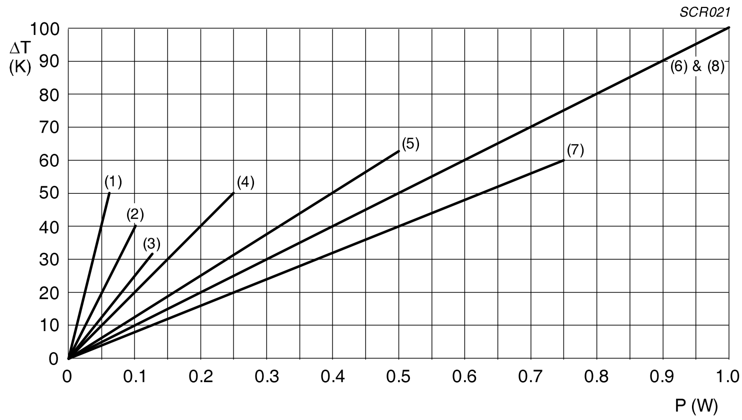


Fig. 2 Heat resistance for 1206 sized resistors as a function of distance and material



(1) For size 0402: Rth = 800 K/W; (2) For size 0603: Rth = 400 K/W
(3) For size 0805: Rth = 250 K/W; (4) For size 1206: Rth = 200 K/W
(5) For size 1210: Rth = 125 K/W; (6) For size 1218: Rth = 100 K/W
(7) For size 2010: Rth = 80 K/W; (8) For size 2512: Rth = 100 K/W

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

FOOTPRINT DIMENSIONS

SINGLE RESISTOR CHIPS

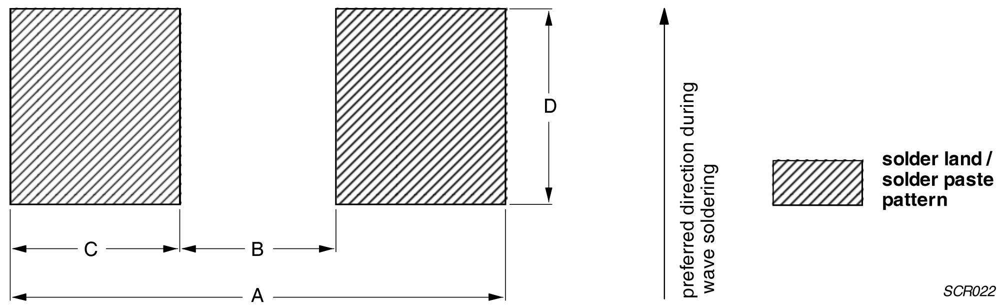


Fig. 4 Single resistor chips recommended dimensions of footprints

Table 1 Reflow soldering footprint dimensions for relevant chip resistors size; see Fig. 4

PRODUCT SIZE CODE	FOOTPRINT DIMENSIONS				Unit: mm
	A	B	C	D	Placement accuracy
0075	0.34	0.14	0.1	0.15	N/A
0100	0.48	0.12	0.18	0.18~0.23	N/A
0201	1.0	0.3	0.35	0.4	N/A
0402	1.5	0.5	0.5	0.6	±0.15
0603	2.6	0.8	0.9	0.8	±0.25
0805	3.0	1.2	0.9	1.2	±0.25
1206	4.2	2.2	1.0	1.5	±0.25
1210	4.2	2.2	1.0	2.4	±0.25
1218	4.2	2.2	1.0	4.8	±0.25
2010	6.1	3.3	1.4	2.4	±0.25
2512	8.0	4.4	1.8	4.0	±0.25

Table 2 Wave soldering footprint dimensions for relevant chip resistors size; see Fig. 4

PRODUCT SIZE CODE	FOOTPRINT DIMENSIONS				Unit: mm
	A	B	C	D	Placement accuracy
0603	2.70	0.90	0.90	0.80	±0.25
0805	3.30	1.30	1.00	1.30	±0.25
1206	4.70	2.50	1.10	1.70	±0.25
1210	4.70	2.50	1.10	2.50	±0.25
1218	4.70	2.50	1.10	4.80	±0.25
2010	6.40	4.20	1.10	2.50	±0.25
2512	8.20	5.50	1.35	3.20	±0.25

RESISTOR ARRAYS, NETWORK AND RF ATTENUATORS

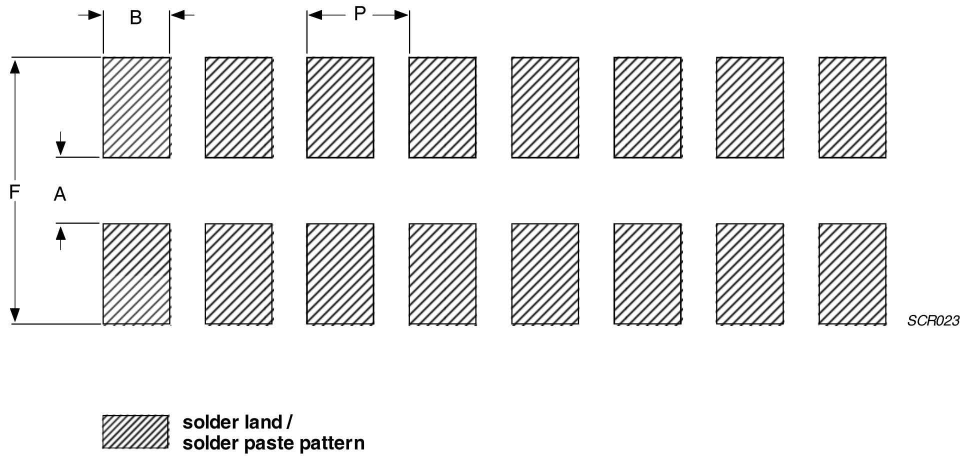


Fig. 5 Resistor arrays and network recommended dimensions of footprints

Table 3 Reflow soldering footprint dimensions for relevant chip resistors size; see Fig. 5

PRODUCT SIZE CODE	TYPE	FOOTPRINT DIMENSIONS			Unit: mm
		A	B	F	P
0404	ATV321	0.50 ±0.10	0.42 ±0.05	1.80 ±0.20	0.65 ±0.05
2 x 0201 (4P2R)	YC 102	0.30 ±0.10	0.30 ±0.05	0.90 ±0.20	0.50 ±0.05
4 x 0201 (8P4R)	YC104	0.30 ±0.10	0.20 ±0.05	0.90 ±0.20	0.40 ±0.05
2 × 0402 (4P2R)	YC/TC 122	0.50 ±0.10	0.30 ±0.05	1.80 ±0.20	0.67 ±0.05
4 × 0402 (8P4R)	YC/TC 124	0.50 ±0.10	0.30 ±0.05	1.80 ±0.20	0.50 ±0.05
2 × 0603 (4P2R)	YC 162	0.80 ±0.10	0.45 ±0.05	2.60 ±0.20	0.80 ±0.05
4 × 0603 (8P4R)	YC/TC 164	0.80 ±0.10	0.45 ±0.05	2.60 ±0.20	0.80 ±0.05
1220 (8P4R)	YC324	2.20 ±0.10	0.71 ±0.05	3.90 ±0.20	1.27 ±0.05
0616 (16P8R)	YC248	0.50 ±0.10	0.30 ±0.05	1.80 ±0.20	0.50 ±0.05
0612 (10P8R)	YC158	0.80 ±0.10	0.35 ±0.05	2.60 ±0.20	0.64 ±0.05
1225 (10P8R)	YC358	1.60 ±0.10	0.90 ±0.05	3.90 ±0.20	1.27 ±0.05

SOLDERING CONDITIONS

The lead free Surface Mount Resistors are able to stand the reflow soldering conditions as below:

- Temperature: above 220 °C
- Endurance: 95 to 120 seconds
- Cycles: 3 times

The test of "soldering heat resistance" is carried out in accordance with the schedule of "*MIL-STD-202G-method 210F*", "The robust construction of chip resistors allows them to be completely immersed in a solder bath of 260 °C for 10 seconds". 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 245 °C during 2 seconds. The test condition for no leaching is 260 °C for 30 seconds. Typical examples of soldering processes that provide reliable joints without any damage, the recommended soldering profiles referring to "*IEC 61760-1*" are given in Figs 6, 7 and 8.

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

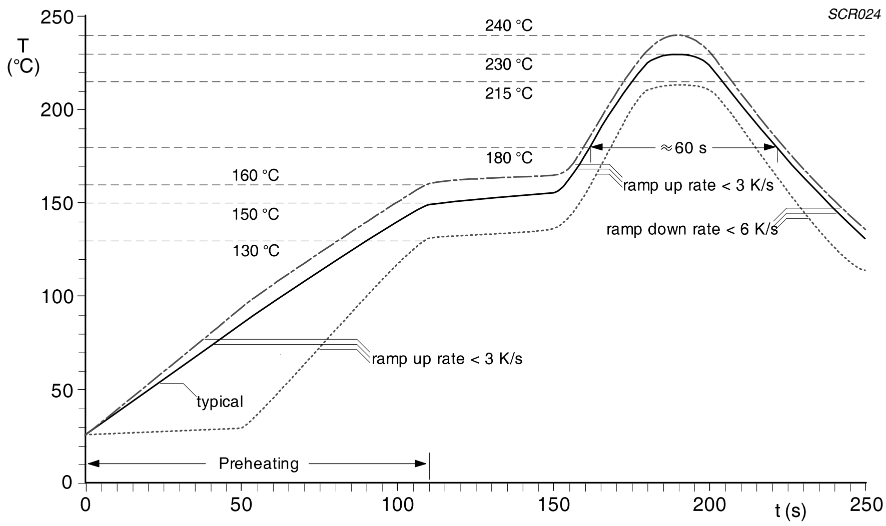


Fig. 6 Infrared soldering, forced air convection reflow soldering-temperature/time profile for SnPb solders

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

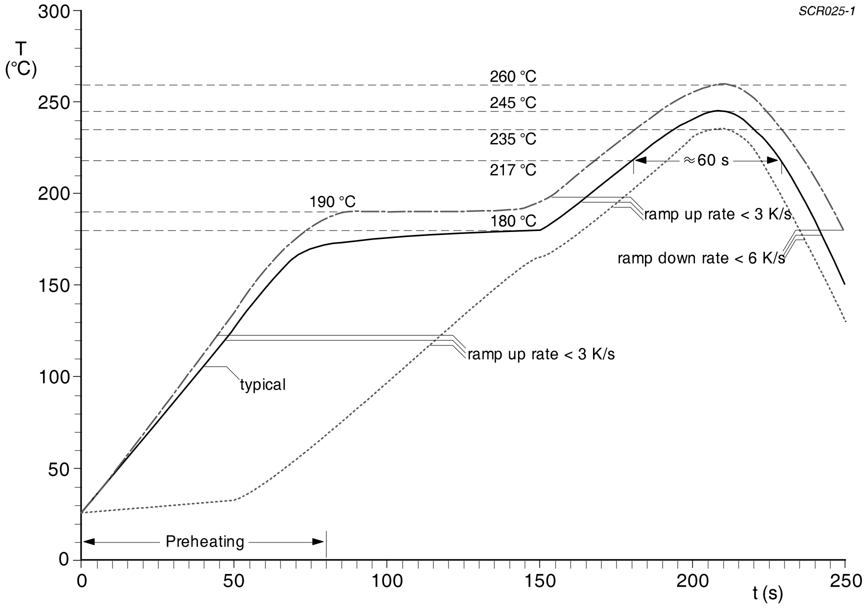


Fig. 7 Infrared soldering, forced air convection reflow soldering-temperature/time profile for SnAgCu solders

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

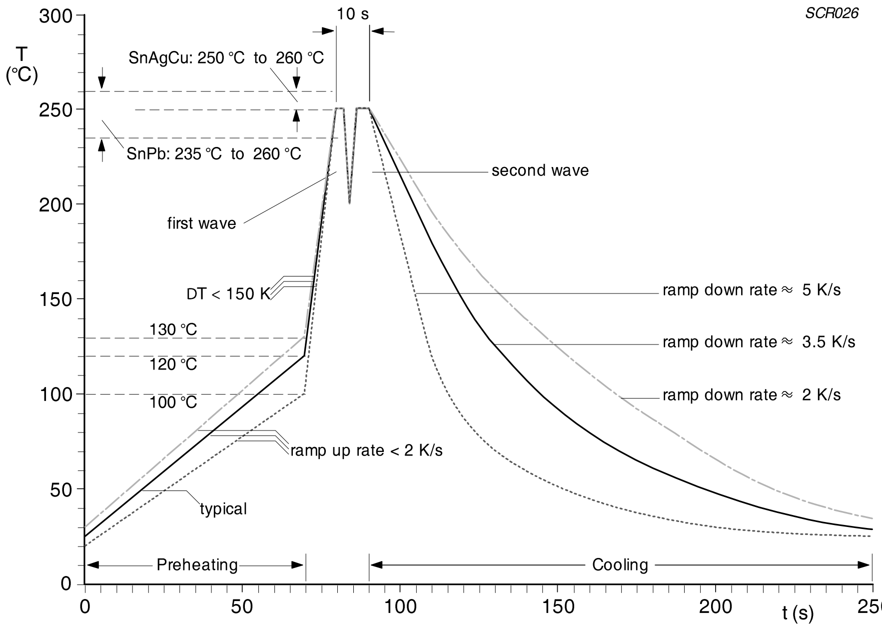


Fig. 8 Double wave soldering for SnPb and leadfree SnAgCu solder– temperature/time profile (terminal temperature)

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 10	Feb. 12, 2018	-	- Update 2512 footprint dimensions
Version 9	Oct. 02, 2017	-	- Correct the highest reflow soldering temperaure of SnAgCu solders to be 260oC
Version 8	June 15, 2017	-	- Add 0075 footprint dimensions
Version 7	Jun. 02, 2015	-	- add 0100
Version 6	Dec. 02, 2014	-	- add YC104
Version 5	March 25, 2008	-	- Footprint dimensions updated - Soldering conditions test method amended from "*MIL-STD-202G*" to "*MIL-STD-202F*" - Solder bath of soldering conditions upgrade to 270 °C - Profiles of infrared soldering amended
Version 4	Nov 26, 2004	-	- Converted to Yageo / Phycomp brand - Expanded sizes from 0201 to 2512 on the profile of "Hot-spot temperature rise (ΔT) as a function of dissipated power" - Footprint dimensions updated - Profiles of infrared and double wave soldering amended
Version 3	Jul 25, 2003	-	- Updated company logo
Version 2	May 30, 2001	-	- Converted to Phycomp brand