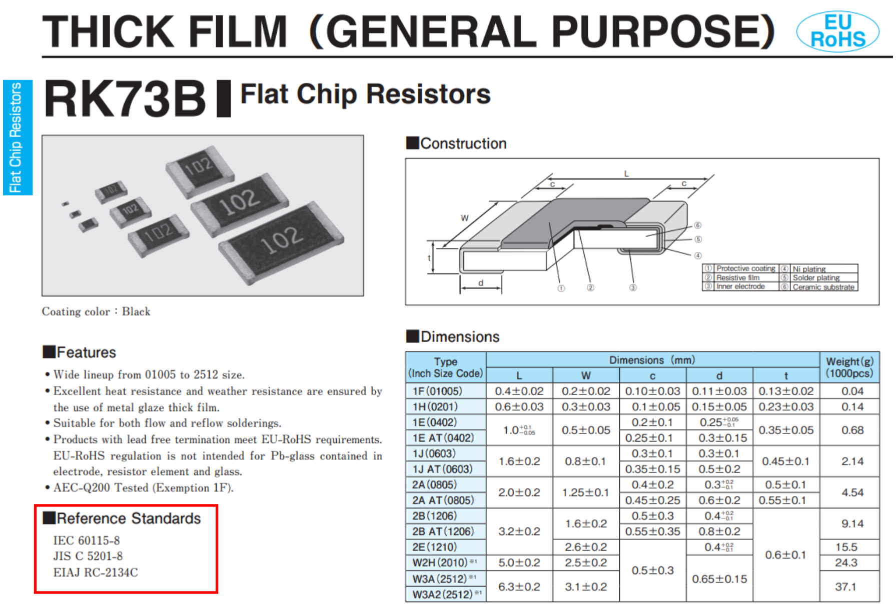
Revision of the International Standard for Chip Resistors

§0 Overview

In August 2023, the international standard for fixed surface mount resistors was revised to the 3rd edition, incorporating the concept of terminal part temperature specification, as KOA has advocated. This technical note explains the key points of the revision of the standard and its benefits to users.

§1 International Standard IEC60115-8

Equipment such as AC adapters for computers bears various marks (e.g. CE, UL, PSE, etc.) that indicate that it has met applicable laws and standards. Although not every resistor bears such marks, there are standards for resistors as well. IEC60115-8 is an international standard for fixed surface mount resistors (hereinafter referred to as "chip resistors") formulated by the IEC (International Electrotechnical Commission). The specifications KOA and many other resistor manufacturers list in their catalogs, such as rated power, nominal resistance, resistance tolerance, resistance temperature coefficient, etc., have been tested and defined based on this international standard. The standards for reference are indicated in the catalogs (see figure 1). The contents of this technical note apply to chip resistors compliant with the 3rd edition of IEC60115-8. KOA products are compliant with the standard.


THICK FILM (GENERAL PURPOSE) EU RoHS

Flat Chip Resistors

RK73B Flat Chip Resistors

Coating color : Black

■Construction

① Protective coating ② Resistive film ③ Inner electrode ④ Ni plating ⑤ Solder plating ⑥ Ceramic substrate

■Features

- Wide lineup from 01005 to 2512 size.
- Excellent heat resistance and weather resistance are ensured by the use of metal glaze thick film.
- Suitable for both flow and reflow solderings.
- Products with lead free termination meet EU-RoHS requirements. EU-RoHS regulation is not intended for Pb-glass contained in electrode, resistor element and glass.
- AEC-Q200 Tested (Exemption 1F).

■Reference Standards

IEC 60115-8
JIS C 5201-8
EIAJ RC-2134C

■Dimensions

Type (Inch Size Code)	Dimensions (mm)					Weight(g) (1000pcs)
	L	W	c	d	t	
1F(01005)	0.4±0.02	0.2±0.02	0.10±0.03	0.11±0.03	0.13±0.02	0.04
1H(0201)	0.6±0.03	0.3±0.03	0.1±0.05	0.15±0.05	0.23±0.03	0.14
1E(0402)	$1.0^{+0.1}_{-0.05}$	0.5±0.05	0.2±0.1	$0.25^{+0.05}_{-0.1}$	0.35±0.05	0.68
1E AT(0402)			0.25±0.1	0.3±0.15		
1J(0603)	1.6±0.2	0.8±0.1	0.3±0.1	0.3±0.1	0.45±0.1	2.14
1J AT(0603)			0.35±0.15	0.5±0.2		
2A(0805)	2.0±0.2	1.25±0.1	0.4±0.2	$0.3^{+0.2}_{-0.1}$	0.5±0.1	4.54
2A AT(0805)			0.45±0.25	0.6±0.2	0.55±0.1	
2B(1206)	3.2±0.2	1.6±0.2	0.5±0.3	$0.4^{+0.2}_{-0.1}$	0.6±0.1	9.14
2B AT(1206)			0.55±0.35	0.8±0.2		
2E(1210)		2.6±0.2	0.5±0.3	$0.4^{+0.2}_{-0.1}$		15.5
W2H(2010)※1	5.0±0.2	2.5±0.2		0.65±0.15		24.3
W3A(2512)※1	6.3±0.2	3.1±0.2				37.1
W3A2(2512)※1						

Figure 1 Product Catalog (Excerpt)

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§2 Points of Standard Revision

In the 3rd edition issued in August 2023, the concept of reference temperature for determining the rated power of chip resistors was significantly changed and the concept of terminal part temperature specification was introduced. The term "terminal part temperature specification" was coined by KOA and proposed to the resistor industry and the electronics industry in 2012 to advocate the concept of changing the reference operating temperature of chip resistors from ambient temperature to the temperature of the terminal (the center of the solder fillet, see figure 2). See the technical notes “Power Derating for Surface Mount Resistors” and “Power Derating Based on Terminal Part Temperature” for more details.

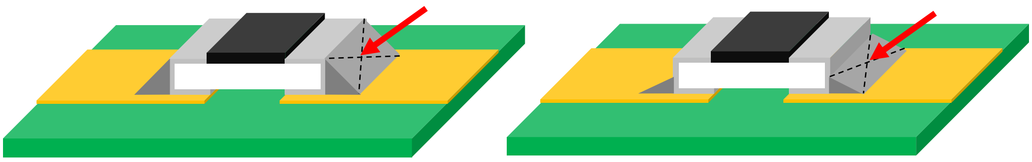

Figure 2 Terminal part location (center of solder fillet)

§3 Benefits of Standard Revision to Customers

This revised standard will make the use of resistors safer for customers by allowing them to know the terminal part temperature when resistors are in use. This will also lead to safer design of electronic equipment.

3.1 Making Safer Use Possible

The revised standard allows customers to know the terminal part temperature during a high-temperature rated power test, which is conducted by the resistor manufacturer to guarantee the rated power of the chip resistor. The terminal part temperature at the time of this test (hereinafter referred to as “environmental test”) is described as the “rated terminal part temperature” in this technical note. In IEC60115-8, this is described as θ_{te70} (meaning the terminal part temperature in a 70°C durability test), and this rated terminal part temperature has been standardized to 125°C as a rule. In the pre-revision standard, there was no concept of terminal part temperature specification, so the rated terminal part temperature was not described. In other words, the only temperature described in the pre-revision standard was the ambient temperature of 70°C, so customers had no way of knowing the terminal part temperature of chip resistors during testing. In the customer's operating environment, the chip resistor is mounted on the circuit board together with various other parts, so the terminal part temperature of the chip resistor is the temperature created by the heat generated by the resistor itself and the surrounding parts. Customers can determine this temperature by measuring the terminal part temperature of chip resistors in their operating environment.

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Since the pre-revision standard did not specify the terminal part temperature when rated power is applied in the environmental test, there was no way of knowing clearly whether the user's measured temperature was lower (allowing a margin of stability) or higher (with greater risk of instability) than the terminal part temperature in the resistor manufacturer's test environment. If the temperature in the customer's operating environment is higher than the testing temperature, it can be dangerous to use the resistor at this temperature that is higher than the temperature confirmed in the test by the manufacturer (see Figure 3-1).

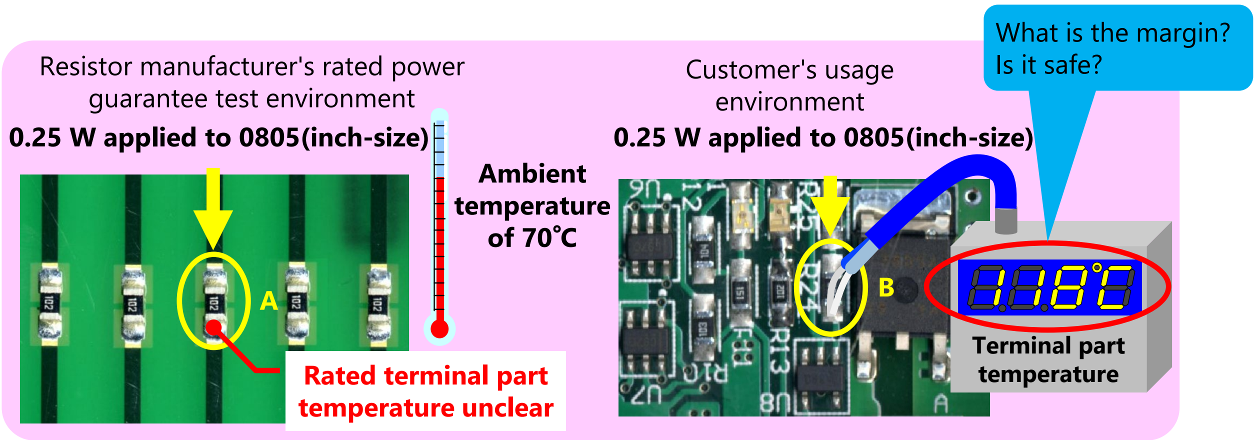

Figure 3-1 Pre-revision Status

In the revised standard, the rated terminal part temperature has been standardized to 125°C as a rule, allowing comparison to be made with the user's operating environment. As shown in Figure 3-2, the terminal part temperature of 118°C in the user's operating environment is lower than the terminal part temperature of 125°C in the test environment, making it lower than the temperature confirmed in the manufacturer's test.

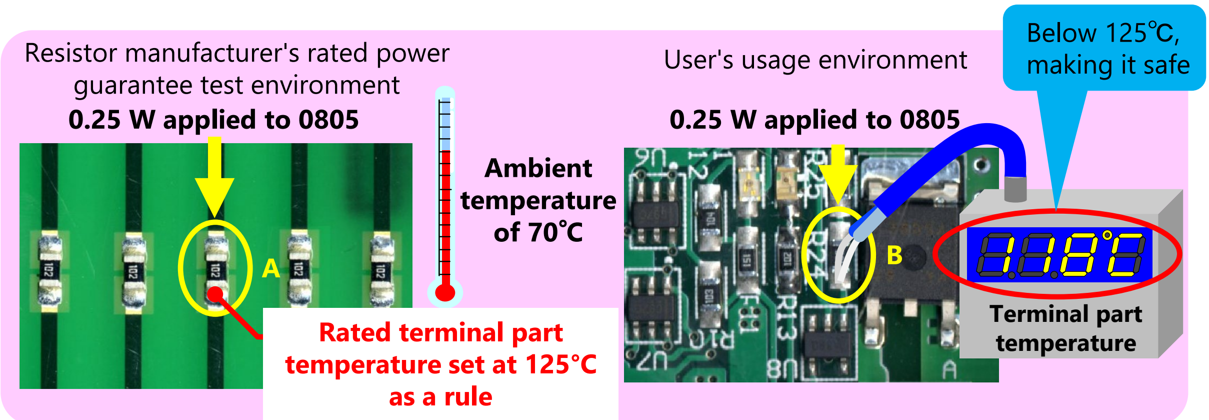

Figure 3-2 Post-revision Status

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3.2 Collective Installation of Chip Resistors

Applications where many chip resistors are arranged together have emerged in recent years. As shown in Figure 4, an experiment was conducted in which many 2512 inch size (6.3 x 3.2 mm) chip resistors with a rated power of 1 W were arranged and left for 30 minutes with rated power applied in an ambient temperature of 25°C. Although the resistors were used within the derating curve with the horizontal axis representing the ambient temperature, the protective coatings on the circuit board and resistors were discolored. From this we understand that in such an installation environment, the conventional ambient-temperature derating curve may not be usable for judging an application. To prevent accidents like this, it was necessary to include the concept of terminal part temperature specification in the standard.

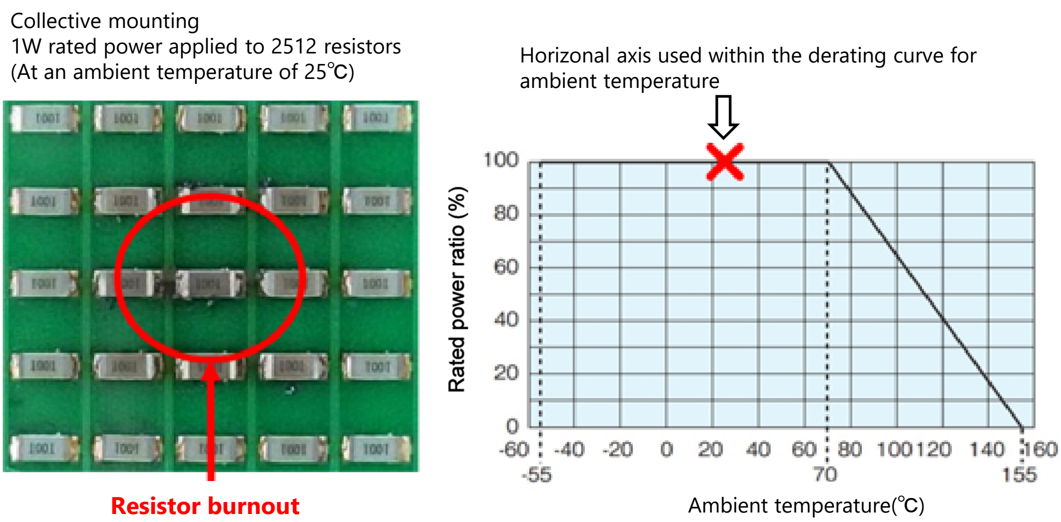

Figure 4 Example of arrangement of multiple chip resistors

3.3 Utilization of Compact/High-Rated Power Chip Resistors

Compact/high-rated power chip resistors with wide terminals were added to the revised standard. In recent years, heat generating density has increased due to the miniaturization and increasing rated power of chip resistors and components, and the high-density mounting of those components on smaller printed circuit boards (PCBs) has led to a situation where the heat dissipation capacity of the PCB alone is insufficient to dissipate heat. Therefore, in order to increase the heat dissipation capacity of the PCB, heat-sink housings have been adopted, in which heat from the back surface of the PCB is directly dissipated to a water-cooled housing through a heat-conductive material such as TIM (thermal interface material). Use of this cooling method keeps the temperature of the terminal and the entire chip resistor low, even when a large amount of power is consumed by the chip resistor. The cooling method described in annex G of the revised standard is shown with an example of a wide-terminal flat chip resistor and a simulated chip resistor temperature.. Figure 5 shows the results of a similar simulation performed at KOA.

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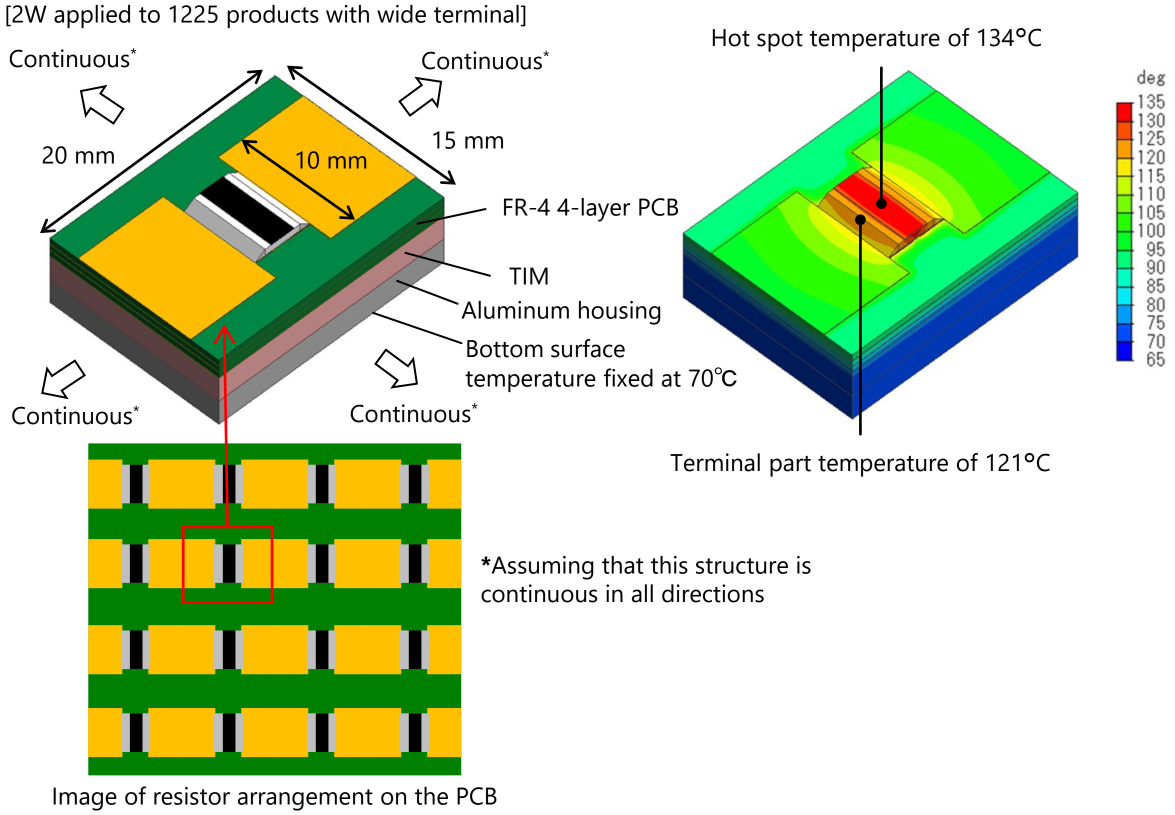

Figure 5 Housing Heat Dissipation (KOA's proprietary simulation)

Annex G shows the temperature increase of high-power chip resistors with long-side electrodes when used under poor heat dissipation conditions. It also shows that power derating based on ambient temperature cannot be used to determine if the chip resistors can be used or not, and the risk of instability cannot be determined using this pre-revision method based on ambient temperature. Figure 6 shows an example of determining usability based on ambient temperature when there is no heat dissipation from the TIM and aluminum housing.

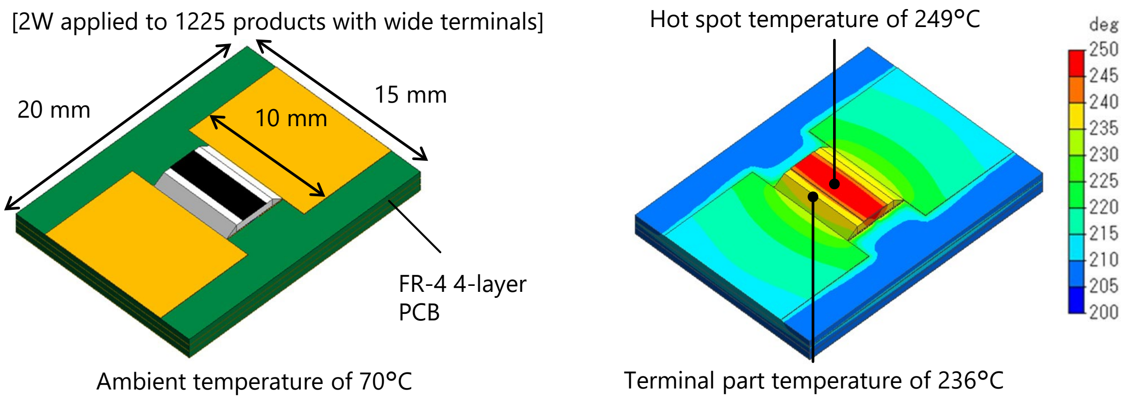

Figure 6 Example of incorrect temperature-control design (KOA's proprietary simulation)

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§4 Summary

The international standard for surface mount resistors, IEC60115-8, has been revised to the 3rd edition, and the concept of terminal part temperature specification as advanced by KOA is now reflected in the standard. This revision has two benefits for customers. The first is that it will make the use of resistors safer for customers by allowing them to know the terminal part temperature when resistors are used in a stable manner. This will also lead to safer design of electronic equipment. The second is that using cooling technology to dissipate an appropriate amount of heat from surface mount resistors makes it possible to use resistors with higher ratings in a small space. Only the terminal part temperature is valid for determining whether or not a high-rated power resistor can be used, and the standard also indicates the risk of making this determination under ambient temperature. KOA delivers a variety of support services, such as offering technical notes on terminal part temperature and providing information on thermal design. Please feel free to contact us for inquiries.

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