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# EIA STANDARD

EIA-60115-8

## Fixed Resistors for Use in Electronic Equipment – Part 8: Sectional Specification - Fixed Surface Mount Resistors

**EIA-60115-8**  
(IEC 60115-8:2009, IDT)

October 2014



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This document is the EIA Standard EIA-60115-8: 2014: *Fixed Resistors for Use in Electronic Equipment – Part 8: Sectional Specification - Fixed Surface Mount Resistors*.

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**(From Standards Proposal No. 5315, formulated under the cognizance of the Steering Committee for Passive Electronic Components Standards (S-1)).**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIXED RESISTORS FOR USE IN ELECTRONIC EQUIPMENT –****Part 8: Sectional specification –  
Fixed surface mount resistors**

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International Standard IEC 60115-8 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This second edition cancels and replaces the first edition, published in 1989, and its Amendment 1 (2000). This second edition constitutes a technical revision and includes test conditions and requirements for lead-free soldering and assessment procedures meeting the requirements of a "zero defect" approach.

The major technical changes with regard to the first edition are the following:

- introduction of a product classification based on application requirements;
- extension of the list of styles and dimensions;
- use of an extended scope of stability class definitions;
- extension of the lists of preferred values of ratings
- inclusion of test conditions and requirements for lead-free soldering, for periodic overload and for resistance to electrostatic discharge (ESD);
- inclusion of a new set of severities for a shear test;

- inclusion of definitions for a test board;
- replacement of assessment level E and possible others by the sole assessment level EZ, meeting the requirements of a “zero defect” approach;
- inclusion of an extended endurance test, a flammability test, a temperature rise test, vibration tests, an extended rapid change of temperature test, and a single pulse high-voltage overload test;
- inclusion of requirements applicable to 0  $\Omega$  resistors (jumpers).

This bilingual version (2013-01) corresponds to the monolingual English version, published in 2009-01.

The text of this standard is based on the following documents:

| FDIS         | Report on voting |
|--------------|------------------|
| 40/1933/FDIS | 40/1970/RVD      |

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts of the IEC 60115 series, under the general title *Fixed resistors for use in electronic equipment*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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## FIXED RESISTORS FOR USE IN ELECTRONIC EQUIPMENT –

### Part 8: Sectional specification – Fixed surface mount resistors

#### 1 General

##### 1.1 Scope

This part of IEC 60115 is applicable to fixed surface mount resistors for use in electronic equipment.

These resistors are typically described according to types (different geometric shapes) and styles (different dimensions). They have metallized terminations and are primarily intended to be mounted directly on to a circuit board.

##### 1.2 Object

The object of this standard is to prescribe preferred ratings and characteristics and to select from IEC 60115-1, the appropriate quality assessment procedures, tests and measuring methods and to give general performance requirements for this type of resistor.

Test severities and requirements prescribed in detail specifications referring to this sectional specification shall be of equal or higher performance level, because lower performance levels are not permitted.

##### 1.3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60062:2004, *Marking codes for resistors and capacitors*

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*  
Amendment 1(1992)

IEC 60068-2-58:2004, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60115-1:2008, *Fixed resistors for use in electronic equipment – Part 1: Generic specification*

IEC 61193-2:2007, *Quality assessment systems – Part 2: Selection and use of sampling plans for inspection of electronic components and packages*

IEC 61340-3-1, *Electrostatics – Part 3-1: Methods for simulation of electrostatic effects – Human body model (HBM) electrostatic discharge test waveforms*

IEC 61760-1:2006, *Surface mounting technology – Part 1: Standard method for the specification of surface mounting components (SMDs)*

#### **1.4 Information to be specified in a detail specification**

Detail specifications shall be derived from the relevant blank detail specification.

Detail specifications shall not specify requirements inferior to those of the generic specification, sectional specification or blank detail specification. When severer requirements are included, they shall be listed in a subclause of the detail specification and indicated in the test schedules, for example by a note.

The following information shall be given in each detail specification and the values quoted shall preferably be selected from those given in the appropriate clause of this sectional specification.

##### **1.4.1 Outline drawing**

There shall be an illustration of the resistor as an aid to easy recognition and for comparison of the resistor with others.

##### **1.4.2 Style and dimensions**

See 2.1.1.

Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be given in the detail specification.

##### **1.4.3 Climatic category**

See 2.1.2.

##### **1.4.4 Limits of resistance change after testing**

See 2.1.4.

##### **1.4.5 Resistance range**

See 2.2.1.

NOTE When products approved according to the detail specification have different ranges, the following statement should be added: "The range of values available in each style, together with the associated tolerance and temperature coefficient, is given in the register of approvals, available for example on the website [www.iecq.org](http://www.iecq.org)".

##### **1.4.6 Tolerances on nominal resistance**

See 2.2.2.

##### **1.4.7 Temperature coefficient of resistance**

See 2.1.3.

##### **1.4.8 Rated dissipation**

See 2.2.3.

The mounting conditions are as described in 2.4.2.

The detail specification shall state the maximum dissipation at temperatures other than 70 °C, for example the derating, either in a diagram or in the form of a statement. All break points shall be verified by test.

#### **1.4.9 Limiting element voltage**

See 2.2.4.

#### **1.4.10 Insulation voltage**

This information is required only for insulated resistors.

See 2.2.6 and the definition in IEC 60115-1, 2.2.10

For small size resistors where the dimensions of the test jig given in IEC 60115-1, 4.6 are not adequate, they shall be specified in the detail specification.

#### **1.4.11 Insulation resistance**

This information is required only for insulated resistors.

See 2.2.5.

For small size resistors where the dimensions of the test jig given in IEC 60115-1, 4.6 are not adequate, they shall be specified in the detail specification.

#### **1.4.12 Marking**

Surface mount resistors are generally not marked on the body. However, if some marking is applied to the body, the resistor shall be marked with the resistance according to IEC 60062, Clause 3 and as many of the remaining items listed in IEC 60115-1, 2.4. All the required information shall be marked on the packaging.

#### **1.4.13 Ordering information**

The detail specification shall specify that the following information is required when ordering resistors:

The number of the detail specification and style reference.

Resistance, tolerance on resistance and temperature coefficient of resistance according to IEC 60062.

#### **1.4.14 Mounting**

The detail specification shall give guidance on methods of mounting for normal use, preferably based on the specification of assembly process conditions of IEC 61760-1, Clause 5. Mounting for test and measurement purposes (when required) shall be in accordance with 2.4.2 of this specification and IEC 60115-1, 4.31.

The detail specification may include additional information (which is not normally required to be verified by the inspection procedure), such as circuit diagrams, curves, drawings and notes needed for the clarification of the detail specification.

### **1.5 Product classification**

The introduction of a product classification permits the user to select performance requirements according to the conditions of the intended end-use application.

Two general end product levels have been established to reflect characteristic differences in functional, performance and reliability requirements and to permit the use of suitable inspection and test schedules. It should be recognized that there may be overlaps of applications between the levels.

**Level G** – General electronic equipment, typically operated under benign or moderate environmental conditions, where the major requirement is function. Examples for level G include consumer products and telecommunication user terminals.

**Level P** – High-performance electronic equipment, where one or more of the following criteria applies:

- uninterrupted performance is desired or mandatory;
- operation in harsh environmental conditions;
- extended lifetime.

Examples for level P include professional equipment, telecommunication transmission systems, industrial control and measurement systems and most automotive applications operated outside the passenger compartment.

Level P is the suitable basis for detail specifications aiming for the approval of components with established reliability.

Each level shall be used in individual detail specifications.

## 2 Preferred characteristics, ratings and test severities

### 2.1 Preferred characteristics

The values given in detail specifications shall preferably be selected from the following.

#### 2.1.1 Style and dimensions

The preferred styles and dimensions are given in Table 1a **Error! Reference source not found.** and Table 1b.

**Table 1a – Preferred styles for rectangular (RR) resistors**

| Style                                                                  |                       | Dimensions            |                      |                                       |
|------------------------------------------------------------------------|-----------------------|-----------------------|----------------------|---------------------------------------|
| Metric                                                                 | Imperial <sup>a</sup> | Length <i>L</i><br>mm | Width <i>W</i><br>mm | Height <i>T</i><br>mm                 |
| RR0603M                                                                | RR0201                | 0,6 ± 0,03            | 0,3 ± 0,03           | 0,23 ± 0,03                           |
| RR1005M                                                                | RR0402                | 1,0 ± 0,05            | 0,5 ± 0,05           | 0,35 ± 0,05                           |
| RR1608M                                                                | RR0603                | 1,6 ± 0,1             | 0,8 ± 0,1            | 0,45 ± 0,1                            |
| RR2012M                                                                | RR0805                | 2,0 ± 0,1             | 1,25 ± 0,15          | 0,5 <sup>+0,15</sup> <sub>-0,10</sub> |
| RR3216M                                                                | RR1206                | 3,2 ± 0,2             | 1,6 ± 0,15           | 0,55 ± 0,1                            |
| RR3225M                                                                | RR1210                | 3,2 ± 0,2             | 2,5 ± 0,2            | 0,55 ± 0,1                            |
| RR3245M                                                                | RR1218                | 3,2 ± 0,2             | 4,6 ± 0,2            | 0,55 ± 0,1                            |
| RR4532M                                                                | RR1812                | 4,6 ± 0,2             | 3,2 ± 0,2            | 0,55 ± 0,1                            |
| RR5025M                                                                | RR2010                | 5,0 ± 0,2             | 2,5 ± 0,2            | 0,55 ± 0,2                            |
| RR6332M                                                                | RR2512                | 6,3 ± 0,2             | 3,2 ± 0,2            | 0,55 ± 0,2                            |
| NOTE Figure 1 shows the shape and dimensions of rectangular resistors. |                       |                       |                      |                                       |
| <sup>a</sup> Historical style codes, for information only.             |                       |                       |                      |                                       |

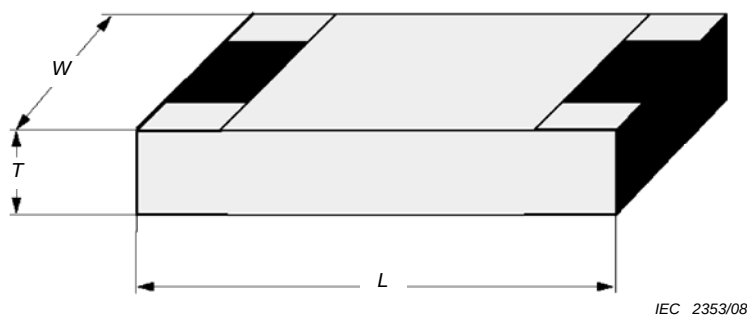


Figure 1 – Shape and dimensions of rectangular (RR) resistors

Table 1b – Preferred styles for cylindrical (RC) resistors

| Style                                                                                                        | Dimensions            |                       |
|--------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|
| Metric                                                                                                       | Length $L$<br>mm      | Diameter $D$<br>mm    |
| RC1610M                                                                                                      | $1,6^{+0,10}_{-0,05}$ | $1,0^{+0,15}_{-0,05}$ |
| RC2012M                                                                                                      | $2,0 \pm 0,1$         | $1,25^{+0,2}_{-0,1}$  |
| RC2211M                                                                                                      | $2,2^{0}_{-0,3}$      | $1,1^{0}_{-0,10}$     |
| RC3514M <sup>a</sup>                                                                                         | $3,5 \pm 0,2$         | $1,4 \pm 0,2$         |
| RC5922M <sup>b</sup>                                                                                         | $5,9 \pm 0,2$         | $2,2 \pm 0,2$         |
| NOTE Figure 2 shows the shape and dimensions of cylindrical resistors.                                       |                       |                       |
| <sup>a</sup> Comparable to historical style: RC3715M ( $L = 3,7^{0}_{-0,4}$ mm; $D = 1,5^{+0,1}_{-0,3}$ mm). |                       |                       |
| <sup>b</sup> Comparable to historical style: RC6123M ( $L = 6,1^{0}_{-0,9}$ mm; $D = 2,3^{+0,2}_{-0,4}$ mm). |                       |                       |

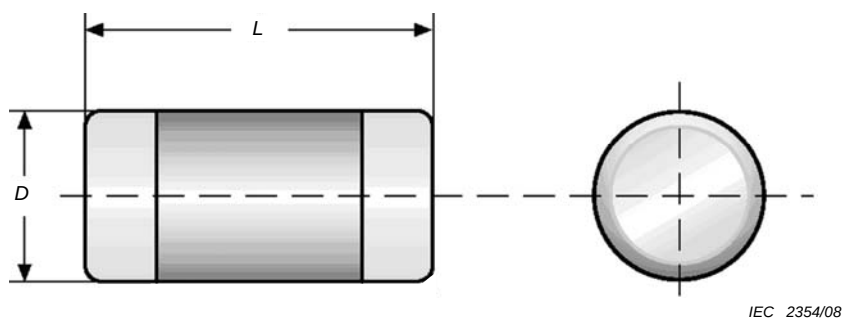


Figure 2 – Shape and dimensions of cylindrical (RC) resistors

When the component style is other than described above, for example for surface mount wirewound resistors, the detail specification shall state such dimensional information as will adequately describe the resistor.

### 2.1.2 Preferred climatic categories

The surface mount resistors covered by this specification are classified into climatic categories according to the general rules given in IEC 60068-1 its Amendment 1 Annex A.

The lower and upper category temperature and the duration of the damp heat, steady state test shall be chosen from the following:

Lower category temperature (LCT)       $-55\text{ }^{\circ}\text{C}$ ;  $-40\text{ }^{\circ}\text{C}$ ;  $-25\text{ }^{\circ}\text{C}$  and  $-10\text{ }^{\circ}\text{C}$ .

Upper category temperature (UCT)       $+85\text{ }^{\circ}\text{C}$ ;  $+100\text{ }^{\circ}\text{C}$ ;  $+125\text{ }^{\circ}\text{C}$ ;  $+155\text{ }^{\circ}\text{C}$ ;  
 $+175\text{ }^{\circ}\text{C}$  and  $+200\text{ }^{\circ}\text{C}$ .

Duration of damp heat, steady state test:      10, 21 and 56 days.

The severities for the cold and dry heat tests are the lower and upper category temperatures respectively.

NOTE The climatic performance of assembled resistors is greatly influenced by the circuit board, the assembly method and a final coating.

### 2.1.3 Variation of resistance with temperature

The preferred limits of change in resistance for the variation of resistance with temperature test are given in Table 2.

**Table 2 – Permitted change of resistance**

| Temperature coefficient                                                                                                                                                                                                                                            |                   | Limit of resistance change<br>%                                          |             |             |             |                                                                                       |              |              |              |              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--------------------------------------------------------------------------|-------------|-------------|-------------|---------------------------------------------------------------------------------------|--------------|--------------|--------------|--------------|
|                                                                                                                                                                                                                                                                    |                   | Lower category temperature / Reference temperature<br>$^{\circ}\text{C}$ |             |             |             | Reference temperature / Upper category temperature <sup>b</sup><br>$^{\circ}\text{C}$ |              |              |              |              |
| $10^{-6}/\text{K}$ <sup>a b</sup>                                                                                                                                                                                                                                  | Code <sup>c</sup> | $-55 / +20$                                                              | $-40 / +20$ | $-25 / +20$ | $-10 / +20$ | $+20 / +85$                                                                           | $+20 / +125$ | $+20 / +155$ | $+20 / +175$ | $+20 / +200$ |
| $\pm 1\,000$                                                                                                                                                                                                                                                       | W                 | $\pm 7,50$                                                               | $\pm 6,00$  | $\pm 4,50$  | $\pm 3,00$  | $\pm 6,50$                                                                            | $\pm 10,5$   | $\pm 13,5$   | $\pm 15,5$   | $\pm 18,0$   |
| $\pm 500$                                                                                                                                                                                                                                                          | V                 | $\pm 3,75$                                                               | $\pm 3,00$  | $\pm 2,25$  | $\pm 1,50$  | $\pm 3,25$                                                                            | $\pm 5,25$   | $\pm 6,75$   | $\pm 7,75$   | $\pm 9,00$   |
| $\pm 250$                                                                                                                                                                                                                                                          | U                 | $\pm 1,88$                                                               | $\pm 1,50$  | $\pm 1,13$  | $\pm 0,75$  | $\pm 1,63$                                                                            | $\pm 2,63$   | $\pm 3,38$   | $\pm 3,88$   | $\pm 4,50$   |
| $\pm 100$                                                                                                                                                                                                                                                          | S                 | $\pm 0,75$                                                               | $\pm 0,60$  | $\pm 0,45$  | $\pm 0,30$  | $\pm 0,65$                                                                            | $\pm 1,05$   | $\pm 1,35$   | $\pm 1,55$   | $\pm 1,80$   |
| $\pm 50$                                                                                                                                                                                                                                                           | R                 | $\pm 0,375$                                                              | $\pm 0,300$ | $\pm 0,225$ | $\pm 0,150$ | $\pm 0,325$                                                                           | $\pm 0,525$  | $\pm 0,675$  | $\pm 0,775$  | $\pm 0,900$  |
| $\pm 25$                                                                                                                                                                                                                                                           | Q                 | $\pm 0,188$                                                              | $\pm 0,150$ | $\pm 0,113$ | $\pm 0,075$ | $\pm 0,163$                                                                           | $\pm 0,263$  | $\pm 0,338$  | $\pm 0,388$  | $\pm 0,450$  |
| $\pm 15$                                                                                                                                                                                                                                                           | P                 | $\pm 0,113$                                                              | $\pm 0,090$ | $\pm 0,068$ | $\pm 0,045$ | $\pm 0,098$                                                                           | $\pm 0,158$  | $\pm 0,203$  | $\pm 0,233$  | $\pm 0,270$  |
| $\pm 10$                                                                                                                                                                                                                                                           | N                 | $\pm 0,075$                                                              | $\pm 0,060$ | $\pm 0,045$ | $\pm 0,030$ | $\pm 0,065$                                                                           | $\pm 0,105$  | $\pm 0,135$  | $\pm 0,155$  | $\pm 0,180$  |
| $\pm 5$                                                                                                                                                                                                                                                            | M                 | $\pm 0,038$                                                              | $\pm 0,030$ | $\pm 0,023$ | $\pm 0,015$ | $\pm 0,033$                                                                           | $\pm 0,053$  | $\pm 0,068$  | $\pm 0,078$  | $\pm 0,090$  |
| $\pm 2$                                                                                                                                                                                                                                                            | L                 | $\pm 0,015$                                                              | $\pm 0,012$ | $\pm 0,009$ | $\pm 0,006$ | $\pm 0,013$                                                                           | $\pm 0,021$  | $\pm 0,027$  | $\pm 0,031$  | $\pm 0,036$  |
| $\pm 1$                                                                                                                                                                                                                                                            | K                 | $\pm 0,008$                                                              | $\pm 0,006$ | $\pm 0,005$ | $\pm 0,003$ | $\pm 0,007$                                                                           | $\pm 0,011$  | $\pm 0,014$  | $\pm 0,016$  | $\pm 0,018$  |
| <sup>a</sup> Abbreviation: e.g. $\pm 50 = 0 \pm 50 \times 10^{-6}/\text{K}$ .<br><sup>b</sup> If additional temperature coefficients are required, these shall be specified in the detail specification.<br><sup>c</sup> Code letters according to IEC 60062, 5.5. |                   |                                                                          |             |             |             |                                                                                       |              |              |              |              |

Each line in the table gives the preferred temperature coefficient and limits of change in resistance for the measurement of the variation of resistance with temperature (see IEC 60115-1, 4.8) on the basis of category temperature ranges of 2.1.2 of this specification.

### 2.1.4 Limits for change in resistance

Tables 3a and 3b list preferred limits for resistance change for all tests listed in the heading. To classify the performance of resistors, they will be assigned to stability classes as listed in Table 3a and Table 3b below.

**Table 3a – Limits for change of resistance**

| Stability class code                                                                                                                                                                                                                                       | Long term tests                                                                                                                        |                                                                         |                                | Short term tests                                                                                                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                            | IEC 60115-1 <sup>a</sup> ,<br>4.23 Climatic sequence<br>4.24 Damp heat, steady state<br>4.25.3 Endurance at upper category temperature | IEC 60115-1 <sup>a</sup> ,<br>4.25.1 Endurance at 70 °C,<br><br>1 000 h | Extended, 8 000 h <sup>d</sup> | IEC 60115-1 <sup>a</sup> ,<br>4.13 Short term overload <sup>b</sup><br>4.18 Resistance to soldering heat<br>4.19 Rapid change of temperature, 5 cycles<br>4.21 Shock <sup>c</sup><br>4.22 Vibration <sup>d</sup><br>4.33 Substrate bending test |
| 5                                                                                                                                                                                                                                                          | $\pm(5 \% R + 0,1 \Omega)$                                                                                                             | $\pm(5 \% R + 0,1 \Omega)$                                              | $\pm(10 \% R + 0,1 \Omega)$    | $\pm(1 \% R + 0,05 \Omega)$                                                                                                                                                                                                                     |
| 2                                                                                                                                                                                                                                                          | $\pm(2 \% R + 0,1 \Omega)$                                                                                                             | $\pm(2 \% R + 0,1 \Omega)$                                              | $\pm(5 \% R + 0,1 \Omega)$     | $\pm(0,5 \% R + 0,05 \Omega)$                                                                                                                                                                                                                   |
| 1                                                                                                                                                                                                                                                          | $\pm(1 \% R + 0,05 \Omega)$                                                                                                            | $\pm(1 \% R + 0,05 \Omega)$                                             | $\pm(2 \% R + 0,05 \Omega)$    | $\pm(0,25 \% R + 0,05 \Omega)$                                                                                                                                                                                                                  |
| 0,5                                                                                                                                                                                                                                                        | $\pm(0,5 \% R + 0,05 \Omega)$                                                                                                          | $\pm(0,5 \% R + 0,05 \Omega)$                                           | $\pm(1 \% R + 0,05 \Omega)$    | $\pm(0,1 \% R + 0,01 \Omega)$                                                                                                                                                                                                                   |
| 0,25                                                                                                                                                                                                                                                       | $\pm(0,25 \% R + 0,05 \Omega)$                                                                                                         | $\pm(0,25 \% R + 0,05 \Omega)$                                          | $\pm(0,5 \% R + 0,05 \Omega)$  | $\pm(0,05 \% R + 0,01 \Omega)$                                                                                                                                                                                                                  |
| 0,1                                                                                                                                                                                                                                                        | $\pm(0,1 \% R + 0,02 \Omega)$                                                                                                          | $\pm(0,1 \% R + 0,02 \Omega)$                                           | $\pm(0,25 \% R + 0,02 \Omega)$ | $\pm(0,05 \% R + 0,01 \Omega)$                                                                                                                                                                                                                  |
| 0,05                                                                                                                                                                                                                                                       | $\pm(0,05 \% R + 0,01 \Omega)$                                                                                                         | $\pm(0,05 \% R + 0,01 \Omega)$                                          | $\pm(0,1 \% R + 0,01 \Omega)$  | $\pm(0,025 \% R + 0,01 \Omega)$                                                                                                                                                                                                                 |
| 0,025                                                                                                                                                                                                                                                      | $\pm(0,025 \% R + 0,01 \Omega)$                                                                                                        | $\pm(0,025 \% R + 0,01 \Omega)$                                         | $\pm(0,05 \% R + 0,01 \Omega)$ | $\pm(0,01 \% R + 0,01 \Omega)$                                                                                                                                                                                                                  |
| <sup>a</sup> IEC 60115-1.<br><sup>b</sup> Test is mandatory only for resistors categorized as level G.<br><sup>c</sup> Test is only applicable to other styles than RR or RC.<br><sup>d</sup> Test is mandatory only for resistors categorized as level P. |                                                                                                                                        |                                                                         |                                |                                                                                                                                                                                                                                                 |