IEC 60115-2

Edition 4.0 2023-02

INTERNATIONAL STANDARD

Fixed resistors for use in electronic equipment –
Part 2: Sectional specification: Low-power film resistors with leads for through-hole assembly on circuit boards (THT)

IEC 60115-2:2023-02(en)

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FOREWORD

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IEC 60115-2 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the definitions of product technologies and product classification levels of the generic specification, IEC 60115-1:2020, have been adopted;
b) the preferred dimensions given in Table 1 have been reviewed, and the legacy style RA_0922 has been removed;
c) a basis for the optional specification of the lead eccentricity of axial leaded resistors has been amended in 4.2;

d) the 'period-pulse high-voltage overload test' of IEC 60115-1:2020, 8.3 has been adopted as default test method in 5.3.8, thereby replacing the legacy test 'periodic-pulse overload test' of IEC 60115-1:2020, 8.4;

e) the revised solderability test of IEC 60115-1:2020, 11.1 has been adopted in 5.3.19 and 5.3.20;

f) the combined solvent resistance test of IEC 60115-1:2020, 11.3 has been adopted in 5.3.22;

g) the 'endurance at room temperature test' of IEC 60115-1:2020, 7.2 (prior IEC 60115 2:2014, Annex C) has been adopted as an optional test in 5.4.1;

h) the 'single-pulse high-voltage overload test' of IEC 60115 1:2020, 8.2, applied with the pulse shape 10/700 in 5.3.7, is complemented with the optional alternative provided by the pulse shape 1,2/50 in 5.4.2;

i) climatic tests for 'operation at low temperature' of IEC 60115-1:2020, 10.2, and for 'damp heat, steady state, accelerated' of IEC 60115-1:2020, 10.5, have been adopted as optional tests in 5.4.4 and 5.4.5, respectively;

j) new guidance is provided in 6.2 on the presentation of stability requirements with their permissible absolute and relative deviations;

k) acceptance criteria for the visual examination have been added in 6.5 and in Annex B;

l) visual examination for the primary and proximity packaging has been added in 6.5.2 and in 7.2;

m) the periodical evaluation of termination platings has been added as a new topic of quality assessment in 9.8;

n) the revised test clause numbering of IEC 60115-1:2020 has been applied;

o) a new Annex C has been added to summarize workmanship requirements for the assembly of leaded film resistors, e.g. as given in the prior IEC 61192 series of standards;

p) the informative Annex F (prior Annex B) on radial formed styles has been amended with details on a formed Z-bend style for surface-mount assembly.

The text of this International Standard is based on the following documents:

Draft	Report on voting
40/2943/CDV	40/3001/RVC

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

The language used for the development of this International Standard is English.

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

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

FIXED RESISTORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 2: Sectional specification: Low-power film resistors with leads for through-hole assembly on circuit boards (THT)

1 Scope

This part of IEC 60115 is applicable to fixed low-power film resistors with termination leads for use in electronic equipment, which are typically assembled in through-hole technology (THT) on circuit boards.

These resistors are typically described according to types (different geometric shapes) and styles (different dimensions) and product technology. The resistive element of these resistors is typically protected by a conformal lacquer coating. These resistors have wire terminations and are primarily intended to be mounted on a circuit board in through-hole technique.

The object of this document is to state 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.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60062:2016, *Marking codes for resistors and capacitors*

IEC 60063:2015, *Preferred number series for resistors and capacitors*

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-20:2021, *Environmental testing – Part 2-20: Tests – Test Ta and Tb – Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60115-1:2020, *Fixed resistors for use in electronic equipment – Part 1: Generic specification*

IEC 60286-1, *Packaging of components for automatic handling – Part 1: Tape packaging of components with axial leads on continuous tapes*

IEC 60294:2012, *Measurement of the dimensions of a cylindrical component with axial terminations*

IEC 60301, *Preferred diameters of wire terminations of capacitors and resistors*

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

3 Terms and definitions

3.1 Terms

For the purposes of this document, the terms and definitions given in IEC 60115-1:2020, 3.1, as well as the following, apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
axial type
physical design of a component with leads extending to both sides along the longitudinal axis of the components body

Note 1 to entry: Figure 1 shows an illustration of a typical axial leaded resistor.

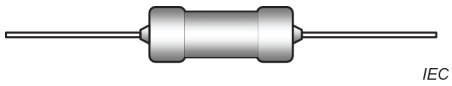
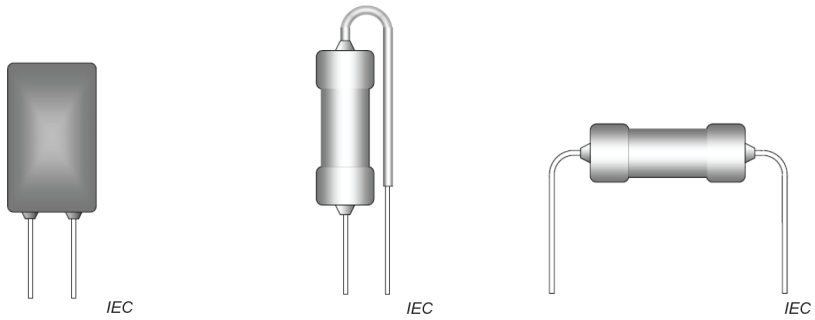


Figure 1 – Illustration of a typical axial leaded resistor

3.1.2
radial type
physical design of a component with leads extending to one side along the longitudinal or along the diagonal axis of the component body

Note 1 to entry: The single direction of the leads may originate from inside the component body or by forming one or both leads outside of the component body, see Figure 2.



a) Radial leaded resistor

b) Radial formed type, upright body position

c) Radial formed type, lateral body position

Figure 2 – Illustrations of typical radial leaded resistors

Note 2 to entry: See Annex F for information on radial formed types.

3.1.3
insulated resistor
resistor that is declared as being insulated by the relevant specification, which in order to support this has a specified insulating voltage and insulation resistance, and which is assessed for these properties with the suitable tests of this specification

Note 1 to entry: The mere existence of a protection of the resistive element, e.g. by means of a lacquer coating, does not constitute an insulation unless the insulating properties have been assessed properly.

Note 2 to entry: Typical tests for the assessment of insulating properties are endurance, climatic sequence and damp heat steady state tests.

[SOURCE: IEC 60115-1:2020, 3.1.7, modified – Note 3 to entry omitted.]

3.2 Product technologies

The definitions of product technologies intend to provide the reader with a guidance on the variety of technologies used for the making of resistors, and to aid their identification.

For the purposes of this document, the following product technologies as described in IEC 60115-1:2020, 3.2 apply:

– metal film technology,
– metal glaze technology,
– metal oxide technology,
– carbon film technology.

3.3 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.

For the purposes of this document, the following product classification levels as defined in IEC 60115-1:2020, 3.4 apply:

– Level G – general electronic equipment
– Level P – high-performance electronic equipment
– Level R – high-performance and high-reliable electronic equipment

4 Preferred characteristics

4.1 General

The values given in detail specifications shall be selected from the values given in 4.2 to 4.9.

4.2 Style and dimensions

4.2.1 Preferred styles and outline dimensions

The shape and dimensions of axial leaded resistors are shown in Figure 3, with preferred styles and their respective dimensions given in Table 1. Style designators of axial leaded film resistors begin with RA.

Table 1 – Preferred styles of axial leaded resistors

Style[a]	Dimensions			
	Body diameter D[c]	Body length L[b]	Lead diameter d[d]	Lead length l_{min}[e]
	mm	mm	mm	mm
RA_0204	$2^{0}_{-0,7}$	$4^{+1,0}_{-1,0}$	0,5	21
RA_0207	$2^{+0,5}_{0}$	$7^{+0,5}_{-2,0}$	0,6	21
RA_0309	$3^{+0,5}_{-0,5}$	$9^{+0,5}_{-2,5}$	0,7	21
RA_0411	$4^{+0,5}_{-1,0}$	$11^{+0,5}_{-3,5}$	0,7	21
RA_0414	$4^{+0,5}_{-1,0}$	$14^{+0,5}_{-4,0}$	0,8	21
RA_0617	$6^{+0,5}_{-1,0}$	$17^{+0,5}_{-4,0}$	0,8	21

[a] The style reference starts with the characters RA, representing Resistor, Axial.
The style reference is completed by a third character for the product technology, as given in 3.2:
M = metal film; G = metal glaze; C = carbon film; X = metal oxide.
The numerals indicate the dimensions of the resistor body, using 2 digits for the diameter D, followed by 2 digits for the length L, both given in tenths of millimetres.
Examples for complete style references are RAM0204, RAX0414.

[b] The body length of the resistor L shall be gauged as described in 5.3.11.

[c] The body diameter of the resistor D shall be gauged as described in 5.3.11.

[d] Nominal diameter of the lead wires d, with permissible tolerances in accordance with IEC 60301.

[e] The minimum lead length l_{min} applies only to the free lead length in tape packaging in accordance with IEC 60286-1.

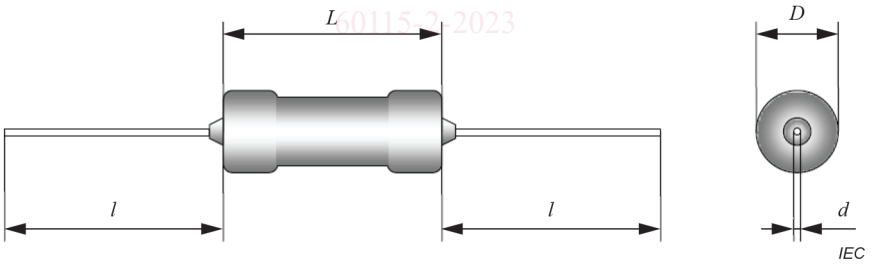


Figure 3 – Shape and dimension of axial leaded resistors

The detail specification shall present a realistic outline illustration of the resistors covered therein, which shall contain all relevant dimensions. The detail specification may deviate from the preferred styles or their recommended dimensions given in Table 1, e.g. due to specific technical requirements or due to deviating styles existing for legacy products.

The recommendation for lead wire diameters in Table 1 applies to standard copper wires with a tin plating. The detail specification may specify other wire materials and other wire diameters where this is justified by specific technical requirements or by a prior specification of a legacy product. Special attention is drawn to the impact of different wire materials or diameters on the thermal conductivity of the lead wires, which affects the thermal management of the products in their application situation. Therefore, a change of wire is likely to require an adaptation of the dissipation rating or of the limiting temperatures and the depending stability data of the affected product.

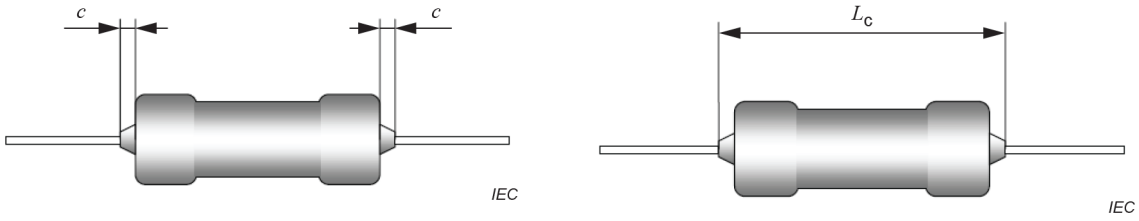
For the specification of any unsolderable area on the lead wires, e.g. due to excessive coating or due to extended welding beads, if required, the provisions of 4.2.2 shall be applied.

For the specification of any eccentricity of the lead wires, if required, the provisions of 4.2.4 shall be applied.

4.2.2 Length of excessive coating or welding bead

As an optional element, the detail specification may specify the permissible length of excessive protective coating extending onto the leads of the resistor, using one of the alternative methods given in Figure 4.

The length of excessive protective coating, dimension c as shown in Figure 4a, shall be gauged as specified in IEC 60294:2012, Clause 4, using a gauge plate of a thickness corresponding to the maximum permissible length of excessive protective coating. A method for measuring or gauging the length between clean leads, dimension L_c, as shown in Figure 4b, shall be stated in the detail specification, if required.



a) Length of excessive coating, c **b) Length between clean leads, L_c**

Figure 4 – Alternative methods for specification of the length of excessive protective coating on axial leaded resistors

4.2.3 Lead wire spacing

Associated with a style and the actual dimensions of the respective products is the shortest possible standard distance of the centre line of the lead wires bent to 90° from the direct axis of the resistor body, which sets the lead-wire spacing S, as shown in Figure 5. The spacing S also defines the minimum grid dimension G of PCB bores into which the resistor can be assembled with its body located lateral on the PCB surface, when the required forming is done in the assembly process.