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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fixed resistors for use in electronic equipment – Part 2: Sectional specification: Leaded fixed low power film resistors

Résistances fixes utilisées dans les équipements électroniques – Partie 2: Spécification intermédiaire: Résistances fixes à broches à couches, à faible dissipation

IEC 60115-2:2014-05(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED RESISTORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 2: Sectional specification: Leaded fixed low power film resistors

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

This third edition cancels and replaces the second edition, published in 1982, and it constitutes a technical revision.

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

– it includes test conditions and requirements for lead-free soldering and assessment procedures meeting the requirements of a "zero defect" approach;
– it introduces a product classification based on application requirements;
– it includes an extension of the list of styles and dimensions;
– it includes the use of an extended scope of stability class definitions;
– it includes the extension of the lists of preferred values of ratings;

– it includes test conditions and requirements for lead-free soldering, for periodic overload and for resistance to electrostatic discharge (ESD);
– it includes a new set of severities for a shear test;
– it includes definitions for a test board;
– it includes the replacement of assessment level E and possible others by the sole assessment level EZ, meeting the requirements of a “zero defect” approach;
– it includes 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;
– it includes requirements applicable to 0 Ω resistors (jumpers);
– it includes recommendations for the denomination, description, packaging and quality assessment of radial formed styles;
– it includes prescriptions for endurance testing at room temperature, supplementary to the rulings of IEC 60115-1.

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

FDIS	Report on voting
40/2282/FDIS	40/2289/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.

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

The committee has decided that the contents of this publication will remain unchanged until the stability 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.

FIXED RESISTORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 2: Sectional specification: Leaded fixed low power film resistors

1 Scope

This part of IEC 60115 is applicable to leaded fixed low-power film resistors for use in electronic equipment.

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 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.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

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

IEC 60068-2-20:2008, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60115-1:2008, *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*

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

3 Terms, definitions, product technologies and product classification

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60115-1:2008, 2.2, as well as the following, apply.

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

3.1.2
radial style
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.

3.2 Product technologies

3.2.1 Metal film technology

The resistive element of a metal film resistor is a thin and homogeneous layer of a metal alloy, deposited on a ceramic core or substrate. Typical examples for such metal alloys are nickel chrome in various compositions and complexities, or tantalum nitride, which are typically deposited by sputtering or by evaporation. The typical thickness of a metal film layer is in the range of 50 nm to 4 μm.

Metal film technology permits achievement of specific levels of temperature stability by choice of material and variation of processing.

Where coding of the resistor technology is required, character M shall be used to identify the metal film technology.

NOTE A common alternative designation for metal film is thin film, which is mainly used for surface mount resistors.

3.2.2 Metal glaze technology

The resistive element of a metal glaze resistor is a thick and heterogeneous layer of a glaze, deposited on a ceramic core or substrate. The glaze is typically filled with ruthenium oxide (noble metal) or with tantalum nitride (non-noble metal) and deposited by coating a cylindrical core, or by printing on a flat substrate. The typical thickness of a metal glaze layer is in the range of 3 μm to 20 μm.

Metal glaze technology permits achievement of several specific levels of temperature stability, mainly by choice of material.

Where coding of the resistor technology is required, character G shall be used to identify the metal glaze technology.

NOTE A common alternative designation for metal glaze is thick film, which is mainly used for flat chip surface mount resistors.

3.2.3 Metal oxide technology

The resistive element of a metal oxide resistor is typically a layer of tin oxide with an addition of antimony, possibly stabilized in a glaze.

Metal oxide technology permits achievement of several specific levels of limited temperature stability.

Where coding of the resistor technology is required, character X shall be used to identify the metal oxide technology.

3.2.4 Carbon film technology

The resistive element of a carbon film resistor is a homogeneous layer of carbon, deposited by fractioning on a ceramic core or substrate.

The temperature stability of carbon film resistors does not offer any controlled variation, but typically depends on the actual resistance.

Where coding of the resistor technology is required, character C shall be used to identify the 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.

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 at the approval of components with established reliability.

Each level shall be used in individual detail specifications.

4 Preferred characteristics

4.1 General

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

4.2 Style and dimensions

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

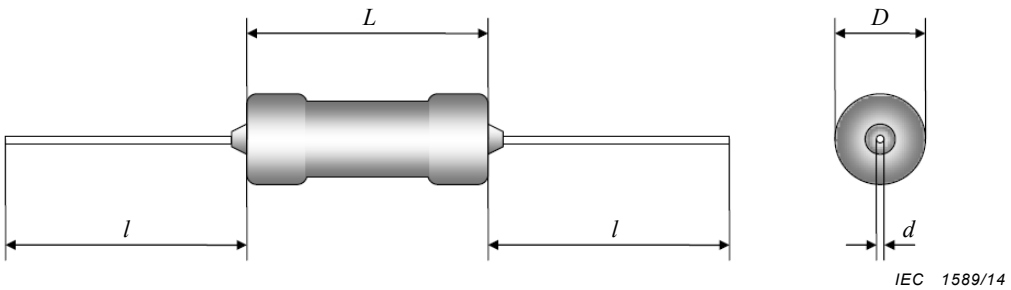


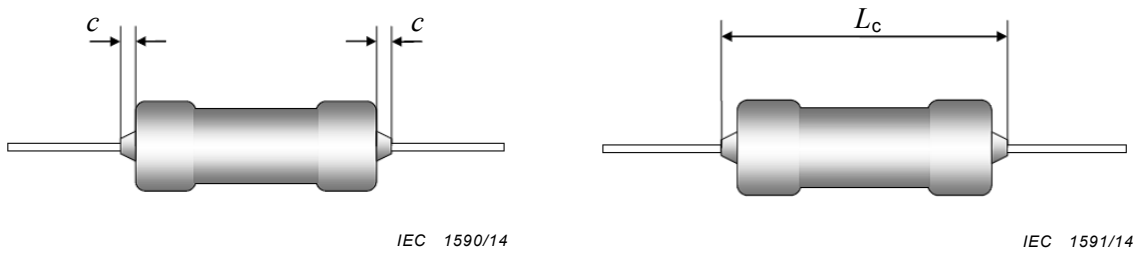
Figure 1 – Shape and dimensions of axial leaded resistors

Table 1 – Preferred styles of axial leaded resistors

Style[a]	Dimensions			
	Body diameter D[c] mm	Body length L[b] mm	Lead diameter d[d] mm	Lead length l_{min}[e] mm
RA_0204	$2^{0}_{-0,7}$	$4^{+1,0}_{-1,0}$	0,5	21
RA_0207	$2^{+0,5}_{0}$	$7^{+0,2}_{-2,0}$	0,6	21
RA_0309	$3^{0}_{-0,5}$	$9^{+0,2}_{-2,5}$	0,7	21
RA_0411	$4^{0}_{-1,0}$	$11^{+0,2}_{-3,5}$	0,7	21
RA_0414	$4^{+0,2}_{-0,5}$	$14^{+0,2}_{-4,0}$	0,8	21
RA_0617	$6^{+0,5}_{-1,0}$	$17^{+0,2}_{-4,0}$	0,8	21
RA_0922	$9^{+0,5}_{-3,0}$	$22^{+0,2}_{-5,0}$	0,8	21

[a] 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.
Examples for complete style references are RAM0204, RAX0414.
[b] The body length of the resistor L shall be measured according to IEC 60294, see 5.2.1.
[c] The body diameter of the resistor D shall be gauged as prescribed in IEC 60294.
[d] Nominal diameter of the lead wires d, with permissible tolerances according to IEC 60301.
[e] The minimum lead length l_{min} applies only to the free lead length in tape packaging according to IEC 60286-1.

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 2.



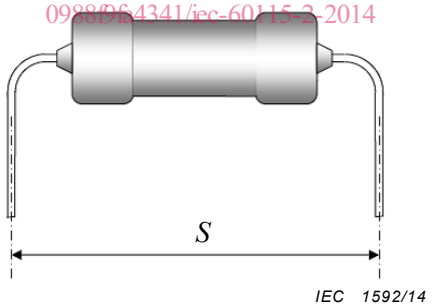
a) Length of excessive coating, c **b) Length between clean leads, L_c**

Figure 2 – Alternative methods for specification of the length of excessive protective coating on axial leaded resistors

The length of excessive protective coating, dimension c, as shown in Figure 2a, shall be gauged as prescribed 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 2b, shall be prescribed in the detail specification, if required.

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, the lead-wire spacing S, as shown in Figure 3. 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.

NOTE The drawing of the resistor with formed leads is not intended to suggest the availability of ready formed resistors in this standard.



NOTE Spacing S is the distance of the centre lines of the bent leads.

Figure 3 – Lead-wire spacing of axial leaded resistors with bent leads

When the component style is other than the one described above, e.g. for radial leaded resistors, the detail specification shall state such dimensional information as will adequately describe the resistor.

4.3 Preferred climatic categories

The leaded film resistors covered by this standard are classified into climatic categories according to the general rules given in IEC 60068-1:2013, 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) –65 °C; –55 °C; –40 °C; –25 °C and –10 °C.

Upper category temperature (UCT) 85 °C; 100 °C; 125 °C; 155 °C; 175 °C and 200 °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.

4.4 Resistance

See IEC 60115-1:2008, 2.3.2.

4.5 Tolerances on resistance

The preferred tolerances on resistance are:

±10 %; ±5 %; ±2 %; ±1 %; ±0,5 %; ±0,25 %; ±0,1 %; ±0,05 %; ±0,02 % and ±0,01 %.

4.6 Rated dissipation P_{70}

The preferred values of rated dissipation P_{70} for mounted resistors at 70 °C ambient temperature are:

0,063 W; 0,125 W; 0,25 W; 0,5 W; 1 W and 2 W.

The detail specification shall specify the conditions under which the rated dissipation applies.

Figure 4 shows the format of a typical derating curve, suitable for providing information on the required derating of the permissible dissipation for any ambient temperature above the rated temperature.

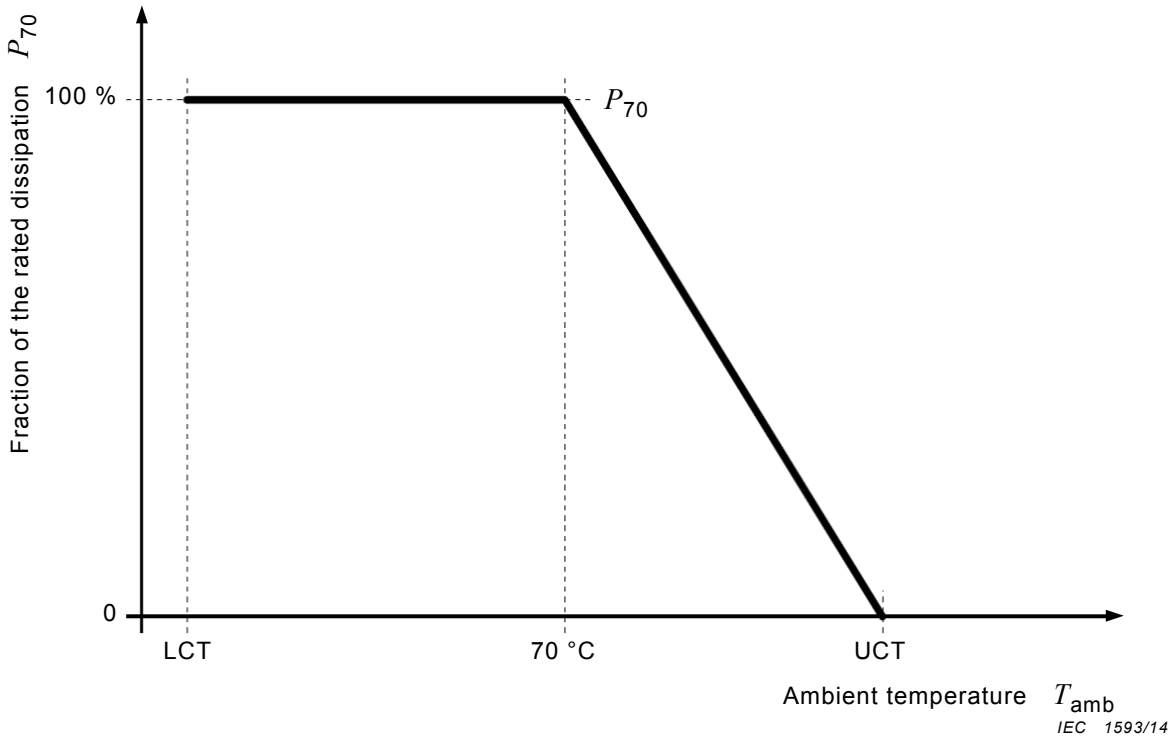


Figure 4 – Derating curve