
Fiksni upori za elektronsko opremo - 1. del: Rodovna specifikacija

Fixed resistors for use in electronic equipment - Part 1: Generic specification

Festwiderstände zur Verwendung in Geräten der Elektronik - Teil 1:
Fachgrundspezifikation

Résistances fixes utilisées dans les équipements électroniques - Partie 1: Spécification
générique

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

Résistances fixes utilisées dans les
équipements électroniques -
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(CEI 60115-1:2008, modifiée)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This document EN 60115-1 consists of the text of IEC 60115-1:2008 prepared by IEC TC 40, Capacitors and resistors for electronic equipment, together with the common modifications prepared by the Technical Committee CENELEC TC 40XB, Resistors.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2012-08-15
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2014-08-15

This document supersedes EN 60115-1:2001 + A1:2001 + A11: 2007.

European common modifications to the text of IEC 60115-1:2008 are indicated by a vertical line in the left margin of the text.

Clauses, subclauses, notes, tables and figures which are additional to those in IEC 60115-1:2008 are prefixed "Z".

Preceding documents on the subject covered by this specification have been:

- EN 140000:1993-12
- CECC 40 000:1973-00, 1979:00

Compared to EN 60115-1:2001, the following changes have been implemented:

- revision of the terms and definitions in 2.2;
- removal of the property "temperature characteristics" from 4.8;
- revision of the solderability test in 4.17;
- revision of the resistance to soldering heat test in 4.18;
- introduction of new bias voltages for the damp heat, steady-state test in 4.24;
- revision of Clause 4.25;
- introduction of new test severities for the single-pulse high-voltage overload test on 4.27;
- introduction of a new system of test severities for the shear test in 4.32;
- deletion of the seal test in 4.36;
- introduction of the operation at low temperature test in 4.36, as a replacement of 4.38;
- revision of the damp heat, steady state, accelerated test in 4.37, as a replacement of 4.39, with introduction of a new test severity
- introduction of the electrostatic discharge test in 4.38, as a replacement of 4.40;
- revision of the periodic-pulse overload test in 4.39, as a replacement of 4.37;
- introduction of a whisker growth test in 4.40;
- deletion of normative Annex A;
- revision of normative Annex B;
- deletion of normative Annexes D and E;
- introduction of informative Annexes F and G;
- revision of normative Annex Q, as a replacement of Clause 3;
- revision of informative Annex ZA;
- revision of normative Annex ZR, as a replacement of Annex ZB;
- editorial revision.

See also the cross reference of informative Annex ZX.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

Endorsement notice

The text of the International Standard IEC 60115-1:2008 was approved by CENELEC as a European Standard with common modifications.

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1 General

1.1 Scope

This part of IEC 60115 is a generic specification and is applicable to fixed resistors for use in electronic equipment.

It establishes standard terms, inspection procedures and methods of test for use in sectional and detail specifications of electronic components for quality assessment or any other purpose.

1.2 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.

EN 60027-1, *Letter symbols to be used in electrical technology - Part 1: General* (IEC 60027-1)

EN 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements* (IEC 60060-1:2010)

EN 60062, *Marking codes for resistors and capacitors* (IEC 60062)

EN 60068-1:1994, *Environmental testing - Part 1: General and guidance* (IEC 60068-1:1988 + A1:1992 + corrigendum Oct. 1988)

EN 60068-2-1, *Environmental testing - Part 2-1: Tests - Test A: Cold* (IEC 60068-2-1)

EN 60068-2-2, *Environmental testing - Part 2-2: Tests - Test B: Dry heat* (IEC 60068-2-2)

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

EN 60068-2-11, *Environmental testing - Part 2-11: Tests - Test Ka: Salt mist* (IEC 60068-2-11)

EN 60068-2-13, *Environmental testing - Part 2-13: Tests - Test M: Low air pressure* (IEC 60068-2-13)

EN 60068-2-14, *Environmental testing - Part 2-14: Tests - Test N: Change of temperature* (IEC 60068-2-14)

EN 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 60068-2-20:2008)

EN 60068-2-21, *Environmental testing - Part 2-21: Tests - Test U: Robustness of terminations and integral mounting devices* (IEC 60068-2-21)

EN 60068-2-27, *Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock* (IEC 60068-2-27)

EN 60068-2-30, *Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)* (IEC 60068-2-30)

EN 60068-2-45, *Environmental testing - Part 2: Tests - Test Xa and guidance: Immersion in cleaning solvents* (IEC 60068-2-45)

EN 60068-2-54, *Environmental testing - Part 2-54: Tests - Test Ta: Solderability testing of electronic components by the wetting balance method* (IEC 60068-2-54)

EN 60068-2-58, *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 60068-2-58)

EN 60068-2-67:1996, *Environmental testing - Part 2: Tests - Test Cy: Damp heat, steady state, accelerated test primarily intended for components* (IEC 60068-2-67:1995)

EN 60068-2-69, *Environmental testing - Part 2-69: Tests - Test Te: Solderability testing of electronic components for surface mounting devices (SMD) by the wetting balance method* (IEC 60068-2-69)

EN 60068-2-78, *Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state* (IEC 60068-2-78)

| EN 60068-2-82:2007, *Environmental testing - Part 2-82: Tests - Test XW1: Whisker test methods for electronic and electric components (IEC 60068-2-82:2007 + corrigendum Dec. 2009)*

EN 60286 (all parts), *Packaging of components for automatic handling*

EN 60695-11-5:2005, *Fire hazard testing - Part 11-5: Test flames - Needle-flame test method - Apparatus, confirmatory test arrangement and guidance (IEC 60695-11-5:2004)*

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

EN 61249-2-7, *Materials for printed boards and other interconnecting structures - Part 2-7: Reinforced base materials, clad and unclad - Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test), copper-clad (IEC 61249-2-7)*

EN 61249-2-22, *Materials for printed boards and other interconnecting structures - Part 2-22: Reinforced base materials, clad and unclad - Modified non-halogenated epoxide woven E-glass laminated sheets of defined flammability (vertical burning test), copper-clad (IEC 61249-2-22)*

EN 61249-2-35, *Materials for printed boards and other interconnecting structures - Part 2-35: Reinforced base materials, clad and unclad - Modified epoxide woven E-glass laminate sheets of defined flammability (vertical burning test), copper-clad for lead-free assembly (IEC 61249-2-35)*

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

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

EN 61760-2, *Surface mounting technology - Part 2: Transportation and storage conditions of surface mounting devices (SMD) - Application guide (IEC 61760-2)*

IEC 60050 (all parts), *International Electrotechnical Vocabulary*

IEC 60063:1963, *Preferred number series for resistors and capacitors*

A1:1967

A2:1977

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IEC 60195, *Method of measurement of current noise generated in fixed resistors*

IEC 60294:1969, *Measurement of the dimensions of a cylindrical component having two axial terminations*

IEC 60410, *Sampling plans and procedures for inspection by attributes*

| IEC/TR 60440, *Method of measurement of non-linearity in resistors*

IEC 60617, *Graphical symbols for diagrams*

| IEC QC 001002-2:1998, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of procedure – Part 2: Documentation*

IEC QC 001002-3:2005, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of procedure – Part 3: Approval procedures*

| IEC QC 210000, *Technology Approval Schedules – Requirements under the IECQ Quality Assessment System for Electronic Components*

| ISO 80000-1, *Quantities and units – Part 1: General*

2 Technical data

2.1 Units and symbols

Units, graphical symbols and letter symbols should, whenever possible, be taken from the following publications:

- EN 60027-1;
- IEC 60050;
- IEC 60617;
- ISO 80000-1.

When further items are required they shall be derived in accordance with the principles of the publications listed above.

2.2 Terms and definitions

For the purposes of this document, the following terms and definitions apply, in alphabetical order of the English terms:

NOTE The sequential numbering of terms and definitions is not suitable for referencing.

2.2.1

category dissipation

fraction of the rated dissipation exactly defined in the detail specification, applicable at the upper category temperature, taking account of the derating curve prescribed in the detail specification

NOTE 1 For resistors the category dissipation is zero, where the upper category temperature is the maximum element temperature.

NOTE 2 Related terminology: rated dissipation, upper category temperature, derating curve.

2.2.2

category temperature range

range of ambient temperatures for which the resistor has been designed to operate continuously; this is given by the lower and upper category temperature

NOTE Related terminology: lower category temperature, upper category temperature.

2.2.3

critical resistance

resistance value at which the rated voltage is equal to the limiting element voltage

NOTE 1 At an ambient temperature of 70 °C, the maximum voltage which may be applied across the terminations of a resistor is either the calculated rated voltage, if the resistance is less than the critical resistance, or the limiting element voltage, if the resistance is equal to or greater than the critical resistance. At temperatures other than 70 °C, it is important that account be taken of the derating curve and of the limiting element voltage in the calculation of any voltage to be applied.

NOTE 2 Related terminology: Rated voltage, limiting element voltage.

2.2.4

derating curve

curve which shows the maximum allowable dissipation at ambient temperatures between the upper and lower category temperature

NOTE 1 In the range between lower category temperature and rated temperature it shows the rated dissipation, and between rated temperature and maximum element temperature it shows a linear slope down to zero dissipation at the maximum element temperature. The slope depends on the thermal properties of the resistor, i.e. its capability to abduct the dissipation to the environment.

NOTE 2 Related terminology: rated dissipation, rated temperature, maximum element temperature.

2.2.5**failure rate level**

accumulated number of non-conforming units under specified operating conditions and specified accumulation time, evaluated for a given confidence level

NOTE Related terminology: non-conformance, non-conforming unit.

2.2.6**grade**

term indicating additional general characteristics concerning the intended application, for example, long-life applications

NOTE 1 The term "grade" may be used only in combination with one or more words (for example, long-life grade) and not with a single letter or number.

NOTE 2 Related terminology: stability class.

2.2.7**heat-sink resistor**

resistor type designed for mounting on a separate heat-sink

NOTE Related terminology: rated dissipation

2.2.8**insulated resistor**

resistor which fulfils the voltage proof and insulation resistance test requirements and the damp-heat, steady-state test with a polarizing voltage applied when mounted on a metal plate

NOTE Related terminology: insulation resistance, insulation voltage.

2.2.9**insulation resistance**

resistance of the encapsulation of the insulated resistor measured between the resistor terminations connected together and any conducting mounting surface

NOTE Related terminology: insulated resistor. [SIST EN 60115-1:2012
https://standards.iteh.ai/catalog/standards/sist/b21acc09-4ad3-4b4b-870b-7d0800c9097c/sist-en-60115-1-2012](https://standards.iteh.ai/catalog/standards/sist/b21acc09-4ad3-4b4b-870b-7d0800c9097c/sist-en-60115-1-2012)

2.2.10**insulation voltage**

maximum peak voltage which may be applied under continuous operating conditions between the resistor terminations and any conducting mounting surface

NOTE Related terminology: insulated resistor.

2.2.11**limiting element voltage**

U_{\max}

maximum d.c. or a.c. r.m.s. voltage that may be continuously applied to the terminations of a resistor (generally dependent upon size and manufacturing technology of the resistor)

NOTE 1 Where the term "a.c. r.m.s. voltage" is used in this standard, the peak voltage is not exceed 1,42 times the r.m.s. value.

NOTE 2 This voltage can only be applied to resistors when the resistance value is equal to or higher than the critical resistance value.

NOTE 3 Related terminology: rated voltage, critical resistance.

2.2.12**Lower Category Temperature**

LCT

minimum ambient temperature at which a resistor has been designed to operate continuously

NOTE Related terminology: upper category temperature, category temperature range.

2.2.13**maximum element temperature****MET**

maximum stated temperature at any point on or within the resistor, under any permissible operating condition

NOTE 1 The maximum element temperature is the sum of the rated temperature and the temperature rise generated by the rated dissipation. For ambient temperature above the rated temperature, the maximum element temperature is the sum of the ambient temperature and the related permissible dissipation as specified by the derating curve.

NOTE 2 Related terminology: maximum surface temperature

2.2.14**maximum surface temperature**

maximum temperature permitted on the surface for any resistor of that type when operated continuously at rated dissipation at an ambient temperature of 70 °C

NOTE Related terminology: maximum element temperature

2.2.15**non-conformance**

characteristic or attribute of a product that does not meet the specified requirement

NOTE Related terminology: non-conforming unit, failure rate level.

2.2.16**non-conforming unit**

unit of product showing one or more non-conformances

NOTE Related terminology: non-conformance, failure rate level.

2.2.17**rated resistance**

resistance value for which the resistor has been designed, and which is generally used for denomination of the resistor

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2.2.18**rated dissipation**

maximum permissible dissipation at an ambient temperature of 70 °C under the conditions of the test endurance at the rated temperature 70 °C and of the respective acceptance criteria

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NOTE 1 If the rated dissipation depends on special means supporting the abduction of the dissipation to the environment, for example, special circuit board material, special conductor dimensions, heat-sink, such means have to be identified whenever the rated dissipation is mentioned.

NOTE 2 The term for heat-sink resistors is defined as maximum allowable dissipation at an ambient temperature of 25 °C, when mounted on the reference heat-sink, under the conditions of the endurance test at room temperature for heat-sink resistors, and which will result in a change in resistance not greater than that specified for this endurance test.

NOTE 3 Related terminology: rated temperature, rated voltage.

2.2.19**rated temperature**

maximum ambient temperature at which the rated dissipation may be applied continuously under the conditions of the endurance test prescribed for this temperature. It has a value of 70 °C, unless otherwise prescribed in the relevant sectional specification

NOTE Related terminology: rated dissipation.

2.2.20**rated voltage** **U_r**

d.c. or a.c. r.m.s. voltage calculated from the square root of the product of the rated resistance and the rated dissipation

NOTE 1 At high values of resistance, the rated voltage may not be applicable because of the size and the construction of the resistor.

NOTE 2 Related terminology: rated dissipation, limiting element voltage.

2.2.21**stability class**

term representing a predefined set of stability requirements, i.e. specific limits of permissible resistance change assigned to individual tests

NOTE 1 The term "stability class" may be used only in combination with a plain number representing the typical stability requirement for long term test, for example, endurance at upper category temperature or 1 000 h endurance at 70 °C. Stability requirements for short term tests will typically be lower than indicated by the stability class number.

NOTE 2 Related terminology: grade.

2.2.22**style**

subdivision of a type, generally based on dimensional factors, which may include several variants, generally of a mechanical order

NOTE Related terminology: type.

2.2.23**surface mount resistor**

fixed resistor whose small dimensions and nature or shape of terminations make it suitable for use in hybrid circuits and on printed boards

NOTE Related terminology: type, style.

2.2.24**temperature coefficient of resistance** **α**

relative variation of resistance between two given temperatures divided by the difference in the temperature producing it

NOTE 1 It should be noted that the use of the term does not imply any degree of linearity for this function, nor should any be assumed.

NOTE 2 Related terminology: variation of resistance with temperature.

2.2.25**temperature rise** **T_r**

increase of temperature on or within a resistor generated by application of a dissipation and depending on the thermal properties of the resistor, i.e. its capability to abduct the dissipation to the environment

2.2.26**type**

group of components having similar design features and manufacturing techniques, enabling them to be considered together either for qualification approval or for quality conformance inspection. They are generally covered by a single detail specification

NOTE 1 Components described in several detail specifications, may, in some cases, be considered as belonging to the same type and may therefore be grouped for quality assessment purposes.

NOTE 2 Mounting accessories are ignored, provided they have no significant effect on the test results.

NOTE 3 Related terminology: style.

2.2.27**Upper Category Temperature****UCT**

maximum ambient temperature at which a resistor has been designed to operate continuously at that portion of the rated dissipation which is indicated in the category dissipation

NOTE 1 For resistors with a linear derating down to zero category dissipation, the upper category temperature is equal to the maximum element temperature.

NOTE 2 Related terminology: lower category temperature, category temperature range.

2.2.28 variation of resistance with temperature

Reversible change of resistance due to temperature deviating from reference conditions, usually described by means of the temperature coefficient of resistance

NOTE Related terminology: temperature coefficient of resistance.

2.2.29 visible damage

damage, perceptible with suitable magnification, which is likely to affect the usability of the component for its intended purpose

2.2.30 voltage coefficient of resistance

reversible change in resistance caused by the applied voltage and expressed as a percentage change in resistance per applied volt

2.3 Preferred values

2.3.1 General

Each sectional specification shall prescribe the preferred values appropriate to the group of products covered therein.

2.3.2 Preferred values of rated resistance

The preferred values of rated resistance shall be taken from a suitable E-series as given in IEC 60063.

2.4 Marking

The information given in the marking is normally selected from the following list; the relative importance of each item is indicated by its position in the list:

- a) rated resistance;
- b) tolerance on rated resistance;
- c) temperature coefficient (if applicable);
- d) year and month (or week) of manufacture;
- e) number of the detail specification and style reference;
- f) manufacturer's name or trade mark;
- g) batch or lot number.

The resistor shall be clearly marked with a) and b) above, and with as many of the remaining items as is practicable. Preferably, the marking method shall be selected from those given in EN 60062. Any duplication of information in the marking on the resistor should be avoided.

Small SMD resistor styles are not generally marked on the body. However, if some marking is applied it shall as a minimum be for the rated resistance, using one of the methods given in of EN 60062. Specific requirements shall be prescribed in the relevant specifications.

The package containing the resistor(s) shall be clearly marked with all the information listed above.

Any additional marking shall be applied so that no confusion can arise.

2.5 Coding

When coding is used for resistance value, tolerance or date of manufacture, the method shall be selected from those given in EN 60062.

2.6 Packaging

Where applicable, the sectional specification shall provide information about packaging, preferably selected from EN 60286 (all parts).