IEC 60115-1

Edition 5.0 2020-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

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

IEC 60115-1:2020-03(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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FIXED RESISTORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 1: Generic specification

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60115-1 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This fifth edition cancels and replaces the fourth edition published in 2008. This edition constitutes a technical revision.

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

a) this 5th edition employs a new document structure, where the tests of prior Clause 4 are given in Clauses 6 to 12 now, with an informative Annex X providing cross-references for references to the prior revision of this standard;
b) the terms and definitions have been revised and amended, supplemented by a new section on resistor technologies and a new section on product classification levels;
c) a new Subclause 4.7 on recommendations for permissible substitutions has been added;

d) the provisions for packaging, storage and transportation in Subclauses 4.8, 4.9 and 4.10 have been completely revised;

e) a new Subclause 5.3 on default tolerances for the most common test parameters has been added;

f) the generic method of measuring resistance, now Sublause 5.6, has been separated from the test for compliance with a prescribed resistance value in 6.1, as a revision of the prior 4.5;

g) the test for the temperature coefficient of resistance of Subclause 6.2 is a revision of the prior test 4.8, variation of resistance with temperature, where the special concessions for resistors below 10 Ω have been waived;

h) the test methods for endurance testing of Subclauses 7.1 to 7.3 (prior 4.25.1 to 4.25.3) have been completely revised;

i) the single-pulse high-voltage overload test of Subclause 8.2 (prior 4.27) has been completely revised, and now offers adjustable severities for the 1,2/50 and for the 10/700 pulse shape for the benefit of detail specifications with improved significance;

j) the periodic-pulse high-voltage overload test of Subclause 8.3 (prior 4.28) has been revised and a corrected table of severities provided;

k) the period-pulse overload test of Subclause 8.4 (prior 4.39) has been deprecated and streamlined to only offer the severity historically applied in subordinate specifications;

l) the Subclauses 9.1 on visual inspection, 9.2 on the gauging of dimensions, and 9.3 on the assessment of detail dimensions (all parts of prior 4.4) have been completely revised;

m) the tests for robustness of terminations (prior 4.16) have been revised and separated into tests for the robustness of solderable terminations, Subclause 9.5, and tests for the robustness of threaded stud or screw terminations, Subclause 9.6;

n) the bump test of Subclause 9.9 (prior 4.20) and the shock test of Subclause 9.10 (prior 4.21) have been revised to reflect the merged relevant test standard IEC 60068-2-29;

o) the dry heat and cold test of the climatic sequence of Subclause 10.3 (prior 4.23) have been revised to reflect the changes of the relevant test standards IEC 60068-2-2 and IEC 60068-2-1;

p) the accelerated damp heat, steady state test of Subclause 10.5 (prior 4.37) has been amended with an option for a reduced number of bias voltages;

q) the corrosion test of Subclause 10.6 has been completely revised in order to employ the better suitable test method of IEC 60068-2-52 instead of the prior used IEC 60068-2-11;

r) the whisker growth test of Subclause 10.7 has been revised to reflect the changes of the new revision of the test methods of IEC 60068-2-82;

s) the test methods for solderability of Subclause 11.1 (prior 4.17) and for resistance to soldering heat of Subclause 11.2 (prior 4.18) have been completely revised to incorporate the necessary option for the variety of lead-bearing and lead-free solder alloys and respective process conditions;

t) the solvent resistance test of Subclause 11.3 combines the prior tests 4.29, component solvent resistance, and 4.30, solvent resistance of marking, in one test;

u) the accidental overload test of Subclause 12.3 (prior 4.26) has been completely revised;

v) the Annex Q on quality assessment procedures has been completely revised;

w) a new Annex R on failure rate evaluation, determination and qualification has been added.

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

FDIS	Report on voting
40/2717/FDIS	40/2733/RVD

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

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

A list of all 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 document will remain unchanged until the stability date indicated on the IEC website under "http://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.

INTRODUCTION

The specification system for fixed resistors for use in electronic equipment is structured in a hierarchical system as shown in Figure 1, consisting of the following specification types.

Generic specification

The generic specification covers all subjects mainly common to the family of fixed resistors for use in electronic equipment, such as terminology, methods of measurement and tests. Where the individual subjects require the prescription conditions or parameters specific to the particular sub-family or type of fixed resistor, such prescriptions are required to be given by one of the subordinate specifications.

For the scope of fixed resistors, the numeric reference to the generic specification is IEC 60115-1.

Sectional specification

Sectional specifications cover all subjects additional to those given in the generic specification, which are specific to a defined sub-group of fixed resistors. These subjects normally are preferred values for dimensions and characteristics, additional test methods and relevant prescriptions for test methods given in the generic specification, prescriptions for sampling and for the preparation of specimen, recommended test severities and preferred acceptance criteria. The sectional specification also outlines the structure and scope of the test schedules which are to be applied in all subordinate detail specifications.

For the scope of fixed resistors, the numeric references to the sectional specifications reach from IEC 60115-2 for leaded fixed low power film resistors to currently IEC 60115-9 for fixed surface mount resistor networks with individually measurable resistors. The variety of sectional specifications may be adapted to the portfolio of different technologies of fixed resistors.

Detail specification

Detail specifications give directly, or by making reference to other documents, all information necessary to completely describe a given type and range of fixed resistors, including prescriptions of all values for dimensions and characteristics. They also give all information required for the quality assessment of the covered type and range of fixed resistors within a suitable quality assessment system, including prescriptions for all applied test severities and acceptance criteria, and the completed test schedules.

Detail specifications can be either specifications within the IEC system, another specification system linked to IEC, or specified by the manufacturer or user. For the scope of fixed resistors, the numeric references to detail specifications are e.g. IEC 60115-2-101; if related to the sectional specification, IEC 60115-2; and if related to the ancillary blank detail specification, IEC 60115-2-1.

Blank detail specification

The hierarchical system of specifications is supplemented by one or more blank detail specification to a sectional specification, which are used to ensure a uniform presentation of detail specifications. The blank detail specifications provide the specification writer with a template on the layout to be adopted and on the information to be given and with guidance for the preparation of detail specifications in line with the requirements of the superior generic or sectional specifications. Blank detail specifications are not considered as relevant specifications since they do not themselves describe any particular component.

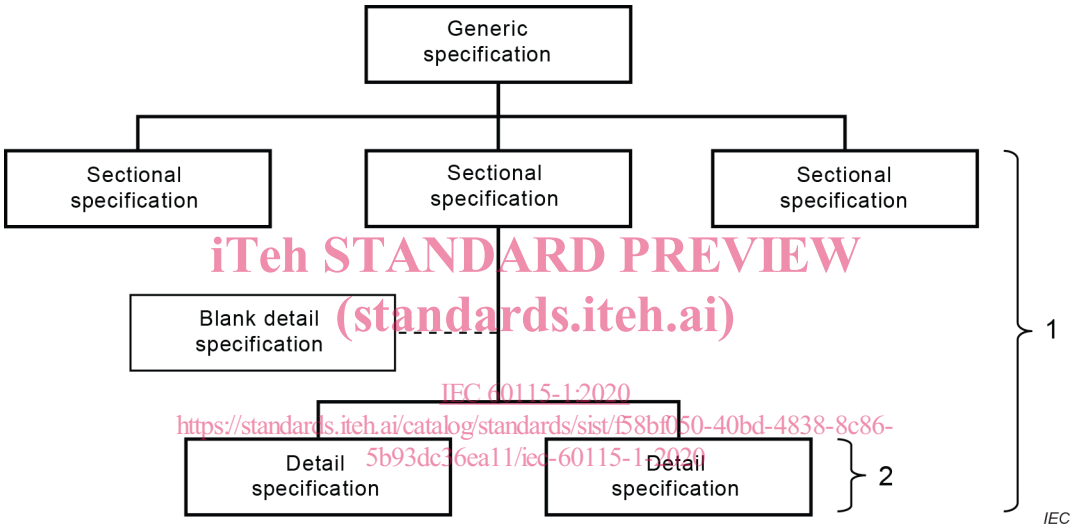
The presence of an established hierarchical specification system with blank detail specifications permits the preparation of detail specifications even outside of the relevant IEC technical committee.

For the scope of fixed resistors, the numeric references to blank detail specifications are e.g. IEC 60115-2-1: if related to the sectional specification, IEC 60115-2.

Relevant specification

In this system the term "relevant specification" addresses subordinate specifications containing specific requirements, where applicable.

Any generic or sectional specification may use abstract and universal references to subordinate specifications of either hierarchical level by use of the expression "relevant specification".



Key

1 Indicates the range of "Relevant specifications" to the superior generic specification, where applicable.

2 Indicates the range of "Relevant specifications" to the superior sectional specification, where applicable.

Figure 1 – Hierarchical system of specifications

FIXED RESISTORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 1: Generic specification

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.

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 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050 (all parts), *International Electrotechnical Vocabulary (IEV)* (available at www.electropedia.org)

IEC 60062, *Marking codes for resistors and capacitors*

IEC 60063, *Preferred number series 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 – Tests A: Cold*

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

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

IEC 60068-2-13, *Basic environmental testing procedures – Part 2-13: Tests – Test M: Low air pressure*

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

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 60068-2-21:2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

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

IEC 60068-2-45:1980, *Basic environmental testing procedures - Part 2-45: Tests - Test XA and guidance: Immersion in cleaning solvents*
IEC 60068-2-45:1980/AMD1:1993

IEC 60068-2-47, *Environmental testing – Part 2-47: Test – Mounting of specimens for vibration, impact and similar dynamic tests*

IEC 60068-2-52, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

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

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

IEC 60068-2-82:2019, *Environmental testing – Part 2-82: Tests – Test Xw1: Whisker test methods for components and parts used in electronic assemblies*

IEC 60195:2016, *Method of measurement of current noise generated in fixed resistors*

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

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

IEC 60440:2012, *Method of measurement of non-linearity in resistors*

IEC 60617, *Graphical symbols for diagrams* (available at http://www.graphical-symbols.info/equipment)

IEC 60695-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 61191 (all parts), *Printed board assemblies*

IEC 61193-2, *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, *Surface mounting technology – Part 1: Standard method for the specification of surface mounting components (SMDs)*

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

IEC 62090, *Product package labels for electronic components using bar code and two-dimensional symbologies*

IEC 62812:2019, *Low resistance measurements – Methods and guidance*

IEC 80000 (all parts), *Quantities and units*

IECQ 03-1:2018, *IEC Quality Assessment System for Electronic Components (IECQ System) – Rules of procedure – Part 1: General Requirements for all IECQ Schemes*

ISO 80000 (all parts), *Quantities and units*

3 Terms, definitions, product technologies and product classifications

NOTE A list of used symbols and abbreviated terms is provided in Annex A.

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

NOTE The numbering of the terms is not a suitable way to refer to terms and their definitions because the numbering could change whenever a term is deleted, or a new term is inserted in its correct place in alphabetical order.

3.1.1
category dissipation

fraction of the rated dissipation exactly defined by the relevant specification, applicable at the upper category temperature, taking into account the derating curve prescribed by the relevant specification

Note 1 to entry: For resistors, the category dissipation is zero, where the upper category temperature is the maximum element temperature.

Note 2 to entry: Related terminology: rated dissipation, upper category temperature, derating curve.

3.1.2
category temperature range

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

Note 1 to entry: Related terminology: lower category temperature, upper category temperature.

3.1.3
critical resistance
R_{crit}

resistance value, at which a specimen is concurrently loaded with the limiting element voltage U_{max} and the rated dissipation P_r, and which is determined by the equation

$$R_{crit} = \frac{U_{max}^2}{P_r}$$

Note 1 to entry: Specimens with a resistance $R < R_{crit}$ and loaded with the rated dissipation P_r, are subjected to a voltage $U < U_{max}$, while specimens with a resistance $R > R_{crit}$ and subjected to the limiting element voltage U_{max}, are loaded with a dissipation $P < P_r$ (see Figure 2).

For consideration of the rated dissipation, the ambient temperature and the derating curve need to be considered.