IEC 61007

Edition 3.0 2020-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Transformers and inductors for use in electronic and telecommunication equipment – Measuring methods and test procedures

Transformateurs et inductances utilisés dans les équipements électroniques et de télécommunications – Méthodes de mesure et procédures d'essais

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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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TRANSFORMERS AND INDUCTORS FOR USE IN ELECTRONIC AND TELECOMMUNICATION EQUIPMENT – MEASURING METHODS AND TEST PROCEDURES

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 61007 has been prepared by IEC technical committee 51: Magnetic components, ferrite and magnetic powder materials.

This third edition cancels and replaces the second edition published in 1994. This edition constitutes a technical revision.

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

a) scope: the application of the scope of IEC 61007 was extended;
b) Clause 2: added new references and updated the references;
c) Clause 3: new definitions were added in 3.3, and in 3.7 the voltage-time product was redefined;

d) test procedures were updated:

   1) addition of test method:

      AC resistance (in 4.4.1.2); short-circuit power test (in 4.4.3.4); efficiency (in 4.4.3.5); phase unbalance (in 4.4.5.7); amplitude unbalance (radio frequency) (in 4.4.5.8); transformation ratio by impedance (in 4.4.7.1); coefficient of coupling (in 4.4.7.2); cross-talk (in 4.4.10);

   2) modification of test method:

      Insulation resistance (an error range of the testing voltage, in 4.4.2.3);

   3) deletion of test method:

      Effective resistance;

e) environmental test procedures: new references were added;

f) Annexes A to G were added.

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

CDV	Report on voting
51/1319/CDV	51/1339/RVC

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.

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.

TRANSFORMERS AND INDUCTORS FOR USE IN ELECTRONIC AND TELECOMMUNICATION EQUIPMENT – MEASURING METHODS AND TEST PROCEDURES

1 Scope

This document describes a number of tests for use in determining the significant parameters and performance characteristics of transformers and inductors for use in electronics and telecommunication equipment. These test methods are designed primarily for transformers and inductors used in all types of electronics applications that can be involved in any specification for such components. Even though these tests can be useful to the other types of transformers used in power distribution applications in utilities, industry, and others, the tests discussed in this document can supplement or complement the tests but are not intended to replace the tests in standards for transformers. Some of the tests described are intended for qualifying a product for a specific application, while others are test practices used for manufacturing and customer acceptance testing. The test methods described here include those parameters most commonly used in the electronics transformer and inductor industry: electric strength, resistance, power loss, inductance, impedance, balance, transformation ratio and many others used less frequently.

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

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 8: Dry heat*

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

IEC 60068-2-7, *Basic environmental testing procedures – Part 2-7: Tests – Test Ga and guidance: Acceleration, steady state*

IEC 60068-2-10, *Environmental testing – Part 2-10: Tests – Test J and guidance: Mould growth*

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 60068-2-17, *Basic environmental testing procedure – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-20, *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, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27, *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 60068-2-42, *Environmental testing – Part 2-42: Tests – Test Kc: Sulphur dioxide test for contacts and connections*

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

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

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

IEC 60270, *High-voltage test techniques – Partial discharge measurements*

IEC 60695-11-2, *Fire hazard testing – Part 11-2: Test flames – 1 kW pre-mixed flame – Apparatus, confirmatory test arrangement and guidance*

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

IEC 61672-1, *Electroacoustics – Sound level meters – Part 1: Specifications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050 (all parts) and the following apply.

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

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

3.1
component
transformer or inductor

3.2
peak working voltage
maximum instantaneous voltage for which the winding insulation is rated under working circuit conditions

3.3
pulse wave form parameters (see Figure 1)

3.3.1
peak pulse amplitude
U_m
maximum value of an extrapolated smooth curve through the top of the pulse, excluding any initial "spike" or "overshoot", the duration of which is less than 10 % of the pulse duration

3.3.2
pulse duration
t_d
time interval between the first and last instant at which the pulse amplitude equals 50 % of the peak pulse amplitude

3.3.3
pulse rise time
t_r
interval between the first instant at which the pulse amplitude reaches 10 % of the peak pulse amplitude and the first instant at which the pulse amplitude reaches 90 % of the peak pulse amplitude, excluding an unwanted or irrelevant portion of the waveform

3.3.4
pulse fall time
t_f
interval between the last instant at which the pulse amplitude reaches 90 % of the peak pulse amplitude and the next instant at which the pulse amplitude reaches 10 % of the peak pulse amplitude excluding any unwanted or irrelevant portion of the waveform

Note 1 to entry: Where the value of the droop approaches 10 % of the peak pulse amplitude, the upper point defining fall time can be replaced by the last instant at which the pulse amplitude reaches 80 % of the peak pulse amplitude.

3.3.5
droop
difference between the peak pulse amplitude and the amplitude of the extrapolated smooth curve through the top of the pulse, excluding any initial "spike" of "overshoot", at its intersection with the straight line through the points defining the pulse fall time, expressed as a percentage of the peak pulse amplitude

3.3.6
pulse crest
maximum amplitude of the pulse

3.3.7
overshoot
amount by which the pulse crest exceeds the peak pulse amplitude, expressed as a percentage of the peak pulse amplitude

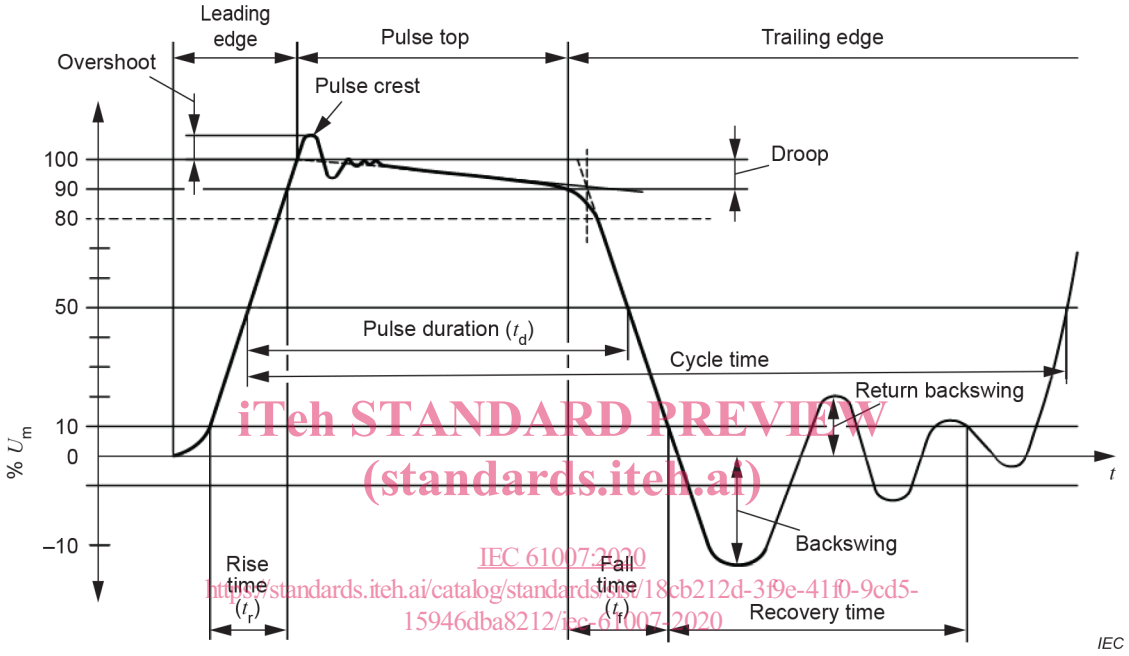
3.3.8
backswing
maximum amplitude of the reverse pulse, i.e. the portion of the pulse after the zero-crossing, expressed as a percentage of the peak pulse amplitude

3.3.9
return backswing
maximum amplitude of the swing that follows the backswing, expressed as a percentage of the peak pulse amplitude

3.3.10
recovery time
time interval between the end of the pulse fall time and the time at which the pulse amplitude last reaches 10 % of the peak pulse amplitude

Note 1 to entry: Exceptionally, a value of less than 10 % may be used, in which case the interval is termed "the X % recovery time".

3.3.11
pulse repetition frequency
average number of pulses in unit time independent of the period over which it is measured



Leading edge: the interval between the first instant at which the pulse amplitude begins and the first instant at which the pulse amplitude reaches the peak pulse amplitude.

Pulse top: the interval between the first instants at which the pulse amplitude equals the peak pulse amplitude and the last instants at which the pulse amplitude equals 90 % of the peak pulse amplitude.

Trailing edge: the interval between the last instants at which the pulse amplitude equals 90 % of the peak pulse amplitude and the first instants at which the pulse amplitude of the second cycle begins.

For clarity in illustrating droop, the 80 % and 10 % points have been used in constructing the line which determines the border between the pulse top and the trailing edge.

Figure 1 – Pulse waveform parameters

3.4
quality factor
***Q* factor**
ratio of the energy stored to the energy dissipated during one cycle at a particular frequency in a specified winding

Note 1 to entry: The Q factor is expressed in terms of either the series or the parallel components of reactance and loss resistance.

3.5
harmonic distortion
square root of the sum of the square of all harmonic voltages up to and including the seventh harmonic (excluding the fundamental) expressed as a percentage or as a ratio in decibels of the fundamental

3.6
maximum winding temperature
mean temperature rise of any winding of the component under full load at maximum ambient temperature, when thermal stability has been achieved, added to the specified maximum ambient temperature

3.7
voltage-time product rating
voltage pulse amplitude multiplied by the time interval between the first and last instants at which the pulse amplitude equals 50 % of the peak pulse amplitude

Note 1 to entry: The start of the pulse within which the non–linearity of the magnetizing current does not exceed a specified value.

3.8
background noise
acoustic noise
noise measured at a measuring point with the component under test not electrically excited

3.9
compass safe distance
distance from the pivot of the test magnetometer of a compass to the nearest on the surface of the component under test, at which the magnetic deviation is limited to a stated value

3.10
duty ratio
ratio of pulse duration t_d to the cycle time

3.11
current transformer parameters

3.11.1
burden
property of the circuit connected to the secondary winding of a current transformer which determines the real and reactive power at the secondary terminals

Note 1 to entry: Burden is expressed as total impedance with effective resistive and reactive components or as the total volt amperes and power factor at the specified values of current and frequency.

3.11.2
current transformation ratio
k
ratio of the RMS value of the primary current to the RMS value of the secondary current under specified conditions

3.11.3
phase angle
angular displacement of the fundamental frequency between the vector representing the primary and secondary currents of the transformer

Note 1 to entry: The phase angle is positive when the secondary current leads the primary current.

3.11.4
ratio error
difference between the measured current transformation ratio k and its nominal value k_n, divided by the measured value k, and expressed as a percentage

$$\frac{k_n - k}{k} \cdot 100\ \%$$

3.12
electrostatic screen
conducting screen inserted between windings that, when it is connected to earth or the points where the voltage potentials are constant, considerably reduces the transference of unwanted signals from one winding to the other via inter-winding capacitance

3.13
safety screen
conducting screen inserted between windings that, when it is connected to earth, effectively prevents fault currents flowing between those windings, in the event of an insulation failure

3.14
polarity
<single–phase windings> property of a single–phase winding such that a terminal on one winding has the same polarity as a terminal on another winding if, when the other ends of the windings are connected to form a common terminal and the transformer/inductor is energized with a sinusoidal voltage, the induced voltage appearing between each of the two terminals and the common terminal rise positively through zero at the same instant of time

3.15
uniformly-insulated winding
winding in which the insulation to earth is, at all points, designed to withstand an electric strength test of a value appropriate to the maximum voltage potential to be applied at the high voltage end

3.16
graded-insulated winding

winding in which insulation to earth is graded from the amount at the high-voltage end to a smaller amount at the low-voltage end

Note 1 to entry: Such a winding should withstand an electric strength test of a value appropriate to the insulation of the low-voltage end.

3.17
frequency weighting characteristic
A
most commonly used frequency curve in the measurement of sound pressure level

4 Test procedures

4.1 Test and measurement conditions

4.1.1 General

Unless otherwise specified, all tests shall be carried out under standard atmospheric conditions for testing as specified in IEC 60068-1. Where there is a requirement for components to attain temperature stability this shall be in accordance with IEC 60068-1:2013, 4.4.

Unless otherwise stated in the detail specification, all voltages and currents shall be sinusoidal; values shall be taken as RMS, and polyphase supplies shall be assumed to be balanced.

The "information to be stated" that is required to complete the descriptions of test methods in Clause 4 shall be specified in the relevant detail specification for the component. The detail specification shall also specify the test fixture to be used in association with a component, where this is intended for use at frequencies high enough for the length of test leads to become significant.