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Transformers and inductors for use in electronic and telecommunication equipment -
Part 389: Measuring methods and test procedures

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IEC/IEEE 61007-389 was prepared by IEC technical committee 51: Magnetic components, ferrite and magnetic powder materials, in cooperation with Standards Committee of the IEEE Power Electronics Society, under the IEC/IEEE Dual Logo Agreement between IEC and IEEE. It is an International Standard.

This document is published as an IEC/IEEE Dual Logo standard.

This first edition of IEC/IEEE 61007-389 cancels and replaces IEC 61007:2020 and IEEE 389:2020, which has been technically revised.

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

a) added the following new test items:
   1) transformer capacitance (in 4.5.6.1);
   2) voltage transformation (VT) ratio (in 4.5.7.3);
   3) thermo-couple method (in 4.5.15.3);
   4) bridge circuit measurement (in 4.5.16.3);
   5) dynamic CM capacitance of a transformer (in 4.5.20);
   6) tests of the parameter in transformer equivalent circuit (in 4.5.21);
b) updated the following test items:
   1) added test purpose: AC resistance (in 4.5.1.2); dielectric withstand voltage test (in 4.5.2.1); effective inductance (in 4.5.4.1); capacitance unbalance (in 4.5.5.1); total harmonic distortion (in 4.5.13);
   2) testing fundamentals and equipment modification: DC winding resistance (in 4.5.1.1); AC resistance (in 4.5.1.2); winding continuity (in 4.5.1.3); excitation apparent-power measurements (in 4.5.3.4); capacitance unbalance (in 4.5.5.1); self-capacitance (distributed capacitance) (in 4.5.6.2); inter-winding capacitance (in 4.5.6.3); inherent self-resonance (in 4.5.8.1); resonant assemblies (in 4.5.8.2); insertion loss (in 4.5.9.1); return loss (in 4.5.9.2); crosstalk (in 4.5.10); pulse characteristics (in 4.5.11.1); transformer response measurements (in 4.5.11.2); total harmonic distortion (in 4.5.13); method utilizing the change in DC resistance of a winding (in 4.5.15.1); method using an additional series-opposing bifilar winding (in 4.5.15.2); safety screens (in 4.5.17.2); magnetic radiation (in 4.5.17.4); acoustic noise (in 4.5.18.1);
   3) procedure modification: dielectric withstand voltage test (in 4.5.2.1); induced voltage test (in 4.5.2.2); capacitance unbalance (in 4.5.5.1);
   4) Information to be stated modification: insulation resistance (in 4.5.2.4); excitation apparent-power measurements (in 4.5.3.4); stray-load losses (in 4.5.3.5); power factor (in 4.5.3.8); inherent self-resonance (in 4.5.8.1); parallel resonance and series resonance (in 4.5.8.3); transformer pulse response (in 4.5.11.3);
c) removed Annex D and Annex F in IEC 61007:2020.

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

Draft	Report on voting
51/1612/FDIS	51/1627/RVD

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.

This document was drafted in accordance with the rules given in the ISO/IEC Directives, Part 2, 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/.

A list of all parts in the IEC 61007 series, published under the general title *Transformers and inductors for use in electronic and telecommunication equipment*, can be found on the IEC website.

The IEC Technical Committee and IEEE Technical Committee have 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, or
– revised.

INTRODUCTION

IEC 61007 describes a number of tests to determine the important parameters and performance characteristics of transformers and inductors used in electronic and telecommunications equipment, aiming to check whether the product meets specific applications and is widely used in industrial manufacturing processes and customer acceptance tests. It includes the test method of electrical testing such as resistance strength, power loss, impedance, inductance value and quality factor, including the test purpose, test procedure and test principle, as well as the reliability test items for electronic transformers and inductors. IEEE Std 389:2020 specifies test and experimental methods applicable to the performance evaluation of electronic transformers and inductors, for the test and evaluation of transformers with lower power ratings (communications, instrumentation, control, small appliance and computer applications). It includes electrical strength, power loss, inductance, impedance and other test items, Kelvin bridge method, impedance bridge method and other measurement methods, but does not include reliability test items and test procedures.

Both documents cover test methods and procedures for electronic transformers and inductors, but they have different emphases and test methods, which bring a lot of inconvenience to users. There is a growing call for establishing an efficient and streamlined universal international standard to meet the needs of developers, customers and the market. Therefore, a proposal for a dual label (IEC/IEEE) standard is formulated to combine IEC 61007 and IEEE Std 389:2020 into one unified new standard.

The structural expression of this document refers to IEC 61007, and on this basis, the expression of test principles, test procedures and test conditions is added for each test item.

This document is a combined and shared standard.

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 could be applied supplementally for other types of transformers, such as those with larger power ratings used in the utility power industry, the tests discussed in this document are not intended to replace the tests in standards for those other 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 https://www.electropedia.org

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, *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, *Environmental testing - 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, *Environmental testing - Part 2-17: Tests - Test Q: Sealing*

IEC 60068-2-20, *Environmental testing - Part 2-20: Tests - Test Ta and Tb: 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 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*

IEC 62024-2, *High frequency inductive components - Electrical characteristics and measuring methods - Part 2: Rated current of inductors for DC-to-DC converters*

IEC 62044-2, *Cores made of soft magnetic materials - Measuring methods - Part 2: Magnetic properties at low excitation level*

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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 60076-10, *Power transformers - Part 10: Determination of sound levels*

IEC 60076-10-1, *Power transformers - Part 10-1: Determination of sound levels - Application guide*

IEC 62044-3:2023, *Cores made of soft magnetic materials - Measuring methods - Part 3: Magnetic properties at high excitation level*

IEEE Std 4, *IEEE Standard for High-Voltage Testing Techniques* [ANSI] [8],[9]

IEEE Std 111, *IEEE Standard for Wide-Band (Greater Than 1 Decade) Transformers* [ANSI]

IEEE Std 260.1, *IEEE Standard Letter Symbols for Units of Measurement (SI Units, Customary Inch- Pound Units, and Certain Other Units)* [ANSI]

IEEE Std 280, *IEEE Standard Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering* [ANSI]

IEEE Std 295, *IEEE Standard for Electronics Power Transformers* [ANSI]

IEEE Std 315, *IEEE Standard Graphic Symbols for Electrical and Electronics Diagrams* [ANSI/DoD]

IEEE Std 390, *IEEE Standard for Pulse Transformers* [ANSI]

IEEE Std 393, *IEEE Standard Test Procedures for Magnetic Cores* [ANSI]

IEEE Std 436, *IEEE Guide for Making Corona (Partial Discharge) Measurements of Electronics Transformers* [ANSI]

IEEE Std C57.12.91, *IEEE Standard Test Code for Dry-Type Distribution and Power Transformers* [ANSI]

ANSI S1.4, *Specification for Sound Level* Meters[10]

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Blume, L. F., *Transformer Engineering*. New York: Wiley, 1951

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Inductors and Transformers for Power Electronics, AlexVan den Bossche, Vencislav Cekov Valchev, 2005, CRC Press. Pgs 20-21

*Magnetic Compone*nts, Peter Zacharias, 2021, Springer, Pgs 285-288

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