IEC 60938-1

Edition 2.0 1999-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

QC 280000

Fixed inductors for electromagnetic interference suppression –
Part 1: Generic specification

Inductances fixes d'antiparasitage –
Partie 1: Spécification générique

IEC 60938-1:1999

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX V

ICS 29.100.10; 31.020

ISBN 2-8318-9863-3

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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 60938-1 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This second edition cancels and replaces the first edition published in 1988 and constitutes a minor revision related to tables, figures and references. It also includes Amendment 1 (2006).

This bilingual version, published in 2008-08, corresponds to the English version.

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

FDIS	Report on voting
40/1110/FDIS	40/1136/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.

The French version of this standard has not been voted upon.

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

A list of all parts of the IEC 60938 series, under the general title: *Fixed inductors for electromagnetic interference suppression*, can be found on the IEC website.

The QC number that appears on the front cover of this publication is the specification number in the IEC quality assessment system for electronic components (IECQ).

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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 INDUCTORS FOR ELECTROMAGNETIC INTERFERENCE SUPPRESSION –

Part 1: Generic specification

1 General

1.1 Scope

This International Standard applies to inductors designed for electromagnetic interference suppression intended for use within, or associated with, electronic or electrical equipment and machines. It is restricted to inductors for which safety tests are appropriate.

The combination of two or more inductors within one enclosure is also included.

Inductors within the scope of this standard may also be used to protect apparatus and machines from electrical noise and voltage or current transients coming from either the supply or from other parts of the apparatus.

This standard does not necessarily apply in its entirety to inductors intended for use on motor vehicles, in aircraft or for marine applications.

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.

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

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

IEC 60062:1992[1)], *Marking codes for resistors and capacitors*

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*
Amendment 1 (1992)

IEC 60068-2-1:1990[1)], *Environmental testing – Part 2: Tests – Tests A: Cold*
Amendment 1 (1993)
Amendment 2 (1994)

IEC 60068-2-2:1974[1)], *Basic environmental testing procedures – Part 2: Tests – Tests B: Dry Heat*
Amendment 1 (1993)
Amendment 2 (1994)

IEC 60068-2-3[2)]:1969, *Basic environmental testing procedures – Part 2: Tests – Test Ca: Damp heat, steady state*
Amendment 1 (1984)

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1) A new edition of this publication exists.

2) This publication has been withdrawn and replaced by IEC 60068-2-78.

IEC 60068-2-6:1995[1)], *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-13:1983, *Environmental testing – Part 2: Tests – Test M: Low air pressure*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*
Amendment 1 (1986)

IEC 60068-2-17:1994, *Basic environmental testing procedures – Part 2: Tests – Test Q: Sealing*

IEC 60068-2-20:1979, *Environmental testing – Part 2: Tests – Test T: Soldering*
Amendment 2 (1987)

IEC 60068-2-21:1983[1)], *Basic environmental testing procedures – Part 2: Tests – Test U: Robustness of terminations and integral mounting devices*
Amendment 2 (1991)
Amendment 3 (1992)

IEC 60068-2-27:1987[1)], *Basic environmental testing procedures – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-29:1987, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*

IEC 60068-2-30:1980[1)], *Basic environmental testing procedures – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle)*
Amendment 1 (1985)

IEC 60068-2-45:1980, *Environmental testing – Part 2: Tests – Test XA and guidance: Immersion in cleaning solvents*
Amendment 1 (1993)

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

IEC 60335-1:1991[1)], *Safety of household and similar electrical appliances – Part 1: General requirements*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 60617 (all parts), *Graphical symbols for diagrams*

IEC 60695-2-2:1991[3)], *Fire hazard testing – Part 2: Test methods – Section 2: Needle-flame test*
Amendment 1 (1994)

CISPR 17:1981, *Methods of measurement of the suppression characteristics of passive radio interference filters and suppression components*

IEC QC 001002-3:1998[1)], *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure – Part 3: Approval procedures*

ISO 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units*

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3) This publication has been withdrawn and replaced by IEC 60695-11-5.

2 Technical data

2.1 Units and symbols

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

IEC 60027

IEC 60050

IEC 60617

ISO 1000

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

2.2 Definitions

For the purpose of this International Standard, the following definitions apply.

2.2.1
type
a group of components having similar design features and the similarity of whose manufacturing techniques enables them to be grouped together either for qualification approval or for quality conformance inspection

They are generally covered by a single detail specification.

NOTE Components described in several detail specifications, may, in some cases, be considered as belonging to the same type.

2.2.2
style
a sub-division of a type, generally based on dimensional factors

A style may include several variants, generally of a mechanical order

2.2.3
family (of electronic components)
a group of electronic components which predominantly displays a particular physical attribute and/or fulfils a defined function

2.2.4
sub-family (of electronic components)
a group of components within a family manufactured by similar technological methods

2.2.5
rated voltage (U_R)
rated voltage is either the maximum r.m.s. operating voltage of rated frequency or the maximum d.c. operating voltage which may be applied continuously to the terminations of the inductor at any temperature between the lower category temperature and the rated temperature

NOTE For inductors with only one winding, the rated voltage should only be applied between one terminal and any conducting surface with which the case is liable to come into contact in normal use. For inductors having more than one winding, the rated voltage may be applied across two individual windings.

2.2.6
category voltage (U_C)
maximum voltage which may be applied continuously to an inductor at its upper category temperature

2.2.7
lower category temperature
minimum external surface temperature for which the inductor has been designed to operate continuously

2.2.8
upper category temperature
maximum external surface temperature for which the inductor has been designed to operate continuously

NOTE The external surface temperature can be affected by internal heating due to the lead-through current. The terminations are considered to be part of the external surface.

2.2.9
rated temperature
maximum ambient temperature at which an inductor can carry its rated current

2.2.10
rated current
maximum r.m.s. operating current at rated frequency or maximum d.c. operating current which allows continuous operation of the inductor at the rated temperature. It is assigned by the manufacturer for one or both of the following conditions:

a) free air (I_{RO});

b) with a specified heat sink (I_{RH}).

2.2.11
rated inductance (L_R)
inductance value for which the inductor has been designed and which is usually indicated upon it

2.2.12
insertion loss
ratio of the voltage before and after the insertion of the suppressor in the circuit as measured at the terminations

NOTE 1 The insertion loss can be measured either with a symmetrical or an asymmetrical test circuit.

NOTE 2 When expressed in decibels, the insertion loss is 20 times the logarithm of the ratio stated.

2.2.13
asymmetrical test circuit
a test circuit in which the inductor under test is connected with a coaxial cable of which the outer conductor constitutes a return path for high-frequency current

[CISPR 17:1981, 3.5 modified]

2.2.14
symmetrical test circuit
a test circuit in which the inductor under test is connected with screened conductor pairs in which the asymmetrical voltage is small enough to be neglected

[CISPR 17:1981, 3.6 modified]

2.2.15
insulated inductor
an inductor in which all terminations connected to a section may be raised to a potential different (but not less than the rated voltage) from that of any conducting surface with which the case is liable to come into contact in normal use

2.2.16
uninsulated inductor
an inductor in which at least one of the terminations connected to a section cannot be raised to a potential different (but not less than the rated voltage) from that of any conducting surface with which the case is liable to come into contact in normal use

2.2.17
electromagnetic interference suppression inductor
an inductor which at mains frequency has a low impedance, but which at radio frequency has a high inductive impedance

NOTE 1 It may be used for reducing the interference at frequencies caused by electrical equipment.

NOTE 2 These inductors are sometimes known as RF chokes.

2.2.18
current-compensated inductor
an inductor having more than one winding on a single core arranged in such a way that the resultant magnetization caused by the current is near zero

2.2.19
earth inductor
an inductor connected in the earth lead of an equipment.

For requirements for earth inductors, see Annex C.

2.2.20
thyristor inductor
an inductor used in thyristor controlled circuits

2.2.21
mains inductor
an inductor intended for direct electrical connection to the supply mains

NOTE This inductor may form part of an equipment.

2.2.22
TV choke
an inductor designed to reduce interference mainly in the frequency range 30 MHz to 300 MHz

NOTE Unencapsulated, non-current compensated TV chokes are not within the scope of this specification, but should be considered as part of the equipment wiring.

2.2.23
visible damage
visible damage which reduces the usability of the inductor unit for intended purpose

2.3 Preferred values

Each sectional specification shall prescribe the preferred values appropriate to the sub-family covered by that sectional specification.

2.4 Marking

2.4.1 General

The sectional specification shall indicate the identification criteria and other information to be shown on the inductors and the packing.

The order of priority for marking small inductors shall be specified.

2.4.2 Coding

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

3 Quality assessment procedures

3.1 General

When these standards are used for the purpose of a full quality assessment system such as the IEC quality assessment system for electronic components (IECQ), compliance to 3.4 or 3.5 is required.

When these standards are used outside quality assessment systems for purposes such as design proving or type testing, the procedures and requirements of 3.4.1 and 3.4.3 may be used, but the tests and parts of tests shall be applied in the order given in the test schedules.

Before inductors can be qualified according to the procedures of this clause, the manufacturer shall obtain the approval of his organization in accordance with the provisions of IEC QC 001002-3.

For certification by an independent test laboratory the procedure of 3.4.3 shall be sufficient, except that the test laboratory will produce the evidence of conformance.

3.2 Primary stage of manufacture

The primary stage of manufacture is the winding of the inductive element(s).

3.3 Structurally similar inductors

The grouping of structurally similar inductors for the purpose of qualification approval and quality conformance inspection shall be prescribed in the sectional specification.

3.4 Qualification approval procedures

3.4.1 Eligibility for qualification approval

The manufacturer shall comply with 3.1.1 of IEC QC 001002-3.

3.4.2 Application for qualification approval

The manufacturer shall comply with 3.1.3 of IEC QC 001002-3.

3.4.3 Test procedure for qualification approval

In addition to the requirements of 3.4.1 and 3.4.2, the manufacturer shall produce test evidence to show conformance to the specification requirements on the fixed sample size test schedule given in the sectional specification.

The specimens taken to form the sample shall be selected at random from current production or as agreed with the National supervising inspectorate (NSI).

3.4.4 Granting of qualification approval

Qualification approval shall be granted when the procedures in accordance with 3.1.4 of IEC QC 001002-3 have been completed satisfactorily.

3.4.5 Maintenance of qualification approval

Qualification approval obtained as part of a quality assessment system shall be maintained by regular demonstration of compliance with the requirements for quality conformance (see 3.5).

3.5 Quality conformance inspection

The blank detail specification(s) associated with the sectional specification shall prescribe the test schedule for quality conformance inspection. This schedule shall also specify the grouping, sampling and periodicity for the lot-by-lot and periodic inspection.

Operation of the switching rule for reduced inspection in group C is permitted in all sub-groups except endurance. Sampling plans and inspection levels shall be selected from those given in IEC 60410.

If required, more than one schedule may be specified.

3.5.1 Certified test records of released lots

When certified test records are requested by a purchaser, they shall be specified in the detail specification.

3.5.2 Delayed delivery

Inductors held for a period exceeding three years (unless otherwise specified in the detail specification) following the release of the lot shall, before delivery, be re-examined as specified in the sectional specification.

Once a lot has been satisfactorily re-inspected, its quality is re-assured for three years from the date of re-inspection.

3.5.3 Release for delivery before the completion of group B tests

When the conditions of IEC 60410 for changing to reduced inspection have been satisfied for all group B tests, the manufacturer is permitted to release components before the completion of such tests.

3.6 Alternative test methods

See 3.2.3.7 of IEC QC 001002-3 with the following details:

In case of dispute, for referee and reference purposes only the specified methods shall be used.

3.7 Unchecked parameters

Only those parameters of a component which have been specified in a detail specification and which are subject to testing can be assumed to be within the specified limits.

It cannot be assumed that any unspecified parameter will remain unchanged from one component to another. Should it be necessary, for any reason, for further parameters to be controlled, then a new, more extensive specification should be used.

The additional test methods shall be fully described and appropriate limits, sampling plans and inspection levels specified.