

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Passive filter units for electromagnetic interference suppression –
Part 1: Generic specification

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Filtres passifs d'antiparasitage –
Partie 1: Spécification générique

IEC 60939-1:2010

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Passive filter units for electromagnetic interference suppression –
Part 1: Generic specification

Filtres passifs d'antiparasitage –
Partie 1: Spécification générique

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**PASSIVE FILTER UNITS FOR ELECTROMAGNETIC
INTERFERENCE SUPPRESSION –****Part 1: Generic specification**

FOREWORD

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International Standard IEC 60939-1 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This third edition cancels and replaces the second edition published in 2005. It constitutes a technical revision.

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

- a) table 3 has been updated, specifying how to handle the Neutral by 3-phase filter with Neutral;
- b) all details about "Quality assessment" have been deleted in this edition, because this standard is a safety standard;
- c) filters shall be subjected to Test Aa of IEC 60068-2-1 for 16 h, using the degree of severity of the lower category temperature as prescribed in the relevant specification;

- d) since IEC 60068-2-20 does no longer make a difference between Method 1A and 1B, but only describes Method 1, references to the method to be used are updated.

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

FDIS	Report on voting
40/2046/FDIS	40/2061/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.

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

A list of all parts of the IEC 60939 series, under the general title *Passive filter units for electromagnetic interference suppression*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability 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

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- withdrawn,
- replaced by a revised edition, or
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PASSIVE FILTER UNITS FOR ELECTROMAGNETIC INTERFERENCE SUPPRESSION –

Part 1: Generic specification

1 General

1.1 Scope

This generic specification relates to passive filter units for electromagnetic interference suppression for use within, or associated with, electronic or electrical equipment and machines.

Both single and multi-channel filters within one enclosure are included within the scope of this generic specification.

Filters constructed of capacitive elements where the inductance is inherent in the construction of the filter are within the scope of this specification. Similarly, filters constructed of inductive elements where the capacitance is inherent in the construction of the filter are also within the scope of this generic specification. The manufacturer should state whether a given component is to be designed as a capacitor, an inductor or a filter.

The filter units within the scope of this generic specification are further distinguished as those for which safety tests are appropriate (e.g. those connected to mains supplies) and those for which such tests are not appropriate. A separate sectional specification covers the passive filter units for which safety tests are appropriate.

This generic specification establishes standard terms, inspection procedures and methods of test for use in sectional and detail specifications within the IECQ-CECC system for electronic components.

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, *Marking codes for resistors and capacitors*

IEC 60068-1:1988, *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 60068-2-13, *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, *Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Soldering*

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

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 + 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 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

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

IEC 60384-14:2005, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

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

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

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

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

2 Terms, definitions and technical data

2.1 Units, symbols and terminology

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

- IEC 60027
- IEC 60050
- ISO 1000

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 the IEC 60939 series, the following terms and definitions apply.

2.2.1

type

group of components having similar design features, the similarity of their manufacturing techniques enabling them to be grouped together either for qualification approval or for quality conformance inspection, and 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 and may therefore be grouped together for approval and quality conformance inspection.

2.2.2

style

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

2.2.3

electromagnetic interference suppression filter unit (filter)

radio interference suppression filter unit

assembly of piece-parts and inductive, capacitive and resistive elements to be used for the reduction of electromagnetic interference caused by electrical or electronic equipment, or other sources

2.2.4

rated voltage

U_R

maximum r.m.s. operating voltage at rated frequency or the maximum d.c. operating voltage which may be applied continuously to the terminations of the filter unit at any temperature between the lower and the upper category temperatures

2.2.5

rated frequency

maximum frequency at which maximum r.m.s. operating voltage may be applied to terminations of the filter

2.2.6

category voltage

U_C

maximum voltage which may be applied to a filter at its upper category temperature

2.2.7

lower category temperature

minimum ambient temperature for which the filter has been designed to operate continuously

2.2.8

upper category temperature

maximum ambient temperature for which the filter unit has been designed to operate continuously

2.2.9

rated temperature

maximum ambient temperature at which a filter can carry its rated current

2.2.10

rated current

maximum r.m.s. operating current through input and output filter terminations at rated frequency or maximum d.c. rating current which allows continuous operation of the filter at the rated temperature, assigned by the manufacturer for one or both of the following conditions:

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- a) free air (I_{RO});
- b) with a specified heat sink (I_{RH})

**2.2.11
rated capacitance**

C_R
capacitance value of capacitive elements of the filter for which a filter has been designed and which may be indicated upon it

**2.2.12
rated inductance**

L_R
inductance value for which the inductor has been designed and which may be indicated upon it

**2.2.13
insertion loss**

ratio of the voltage before and after the insertion of the filter in the circuit as measured at the terminations either with a symmetrical or an asymmetrical test circuit

NOTE It is normally expressed in decibels, when the insertion loss is 20 times the logarithm to base 10 of this ratio.

**2.2.14
asymmetrical test circuit**

test circuit in which the filter under test is connected as a 3-terminal network, one terminal of which is connected to earth

NOTE The signal is applied between the input terminal and earth, and the output is measured between the output terminal and earth. There is a common (earth) connection between generator, filter and receiver (see Figure 1).

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**2.2.15
symmetrical test circuit**

test circuit in which the filter under test is connected as a 4-terminal network

NOTE 1 The test signal applied to the two input terminals symmetrically about earth, i.e. equal in magnitude but of opposite phase on the two terminals (see Figure 1). The output is measured between the other two terminals.

NOTE 2 It is usual to perform symmetrical tests using an asymmetrical generator and receiver with suitable balance-to-unbalance transformers connected between them and the filter under test.

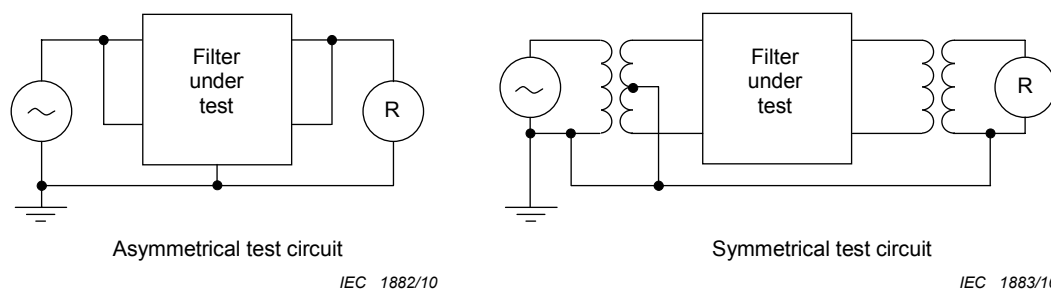


Figure 1 – Asymmetrical and symmetrical test circuit

**2.2.16
visible damage**

visible damage which reduces the usability of the filter for its intended purpose

**2.2.17
passive flammability**

ability of a filter to burn with a flame as a consequence of the application of an external source of heat

2.2.18**active flammability**

ability of a filter to burn with a flame as a consequence of electrical loading

2.2.19**impedance of protective conductor**

impedance of the protective conductor is the impedance measured between the conductor input and the conductor output of the filter for a specified current overload

2.2.20**leakage current** **I_{LK}**

current at rated frequency flowing to earth or to an extraneous-conductive-part in a faultless circuit. This current can have a capacitive component, especially caused by the use of capacitors.

It is a theoretically calculated value for uniform indications, such as in catalogues. The calculation is based on the provisions detailed in the Annex A.

The actual leakage current cannot be stated in the individual case.

NOTE Other leakage currents such as touch currents and protective conductor currents shall be determined according to the relevant standard (e.g. IEC 60990).

2.3 Preferred values

Each sectional specification shall prescribe the preferred values appropriate to the subfamily covered by that sectional specification.

2.4 Marking

IEC 60939-1:2010

2.4.1 General

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

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.

2.5 Components

Components other than inductors and capacitors in the filter unit shall fulfill requirements in the relevant IEC standard.

3 Test and measurement procedures**3.1 General**

The sectional and/or blank detail specification shall contain tables showing the tests to be made, which measurements are to be made before and after each test or subgroup of tests, and the sequence in which they shall be carried out. The stages of each test shall be carried out in the order written. The measuring conditions shall be the same for initial and final measurements.

If national specifications within any quality assessment system include methods other than those specified in the above documents, they shall be fully described.

3.2 Standard atmospheric conditions

3.2.1 Standard atmospheric conditions for testing

Unless otherwise specified, all tests and measurements shall be made under standard atmospheric conditions for testing as given in 5.3 of IEC 60068-1:1988.

- temperature: 15 °C to 35 °C;
- relative humidity: 45 % to 75 %;
- air pressure: 86 kPa to 106 kPa.

Before the measurements are made, the filter shall be stored at the measuring temperature for a time sufficient to allow the entire filter to reach this temperature. The period prescribed for recovery at the end of a test is normally sufficient for this purpose.

When measurements are made at a temperature other than the specified temperature, the results shall, where necessary, be corrected to the specified temperature. The ambient temperature during the measurements shall be stated in the test report. In the event of a dispute, the measurements shall be repeated, using one of the referee temperatures (as given in 3.2.3) and such other conditions as are prescribed in this generic specification.

When tests are conducted in a sequence, the final measurements of one test may be taken as the initial measurements for the succeeding test.

During measurements, the filter shall not be exposed to draughts, direct sunrays or other influences likely to cause error.

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3.2.2 Recovery conditions

Unless otherwise specified, recovery shall take place under the standard atmospheric conditions for testing (see 3.2.1).

If recovery has to be made under closely controlled conditions, the controlled recovery conditions of 5.4.1 of IEC 60068-1:1988 shall be used.

Unless otherwise specified in the relevant sectional or detail specification, a duration of 1 h to 2 h shall be used.

3.2.3 Referee conditions

For referee purposes, one of the standard atmospheric conditions for referee tests taken from 5.2 of IEC 60068-1:1988, as given in Table 1, shall be chosen.

Table 1 – Standard atmospheric conditions

Temperature °C	Relative humidity %	Air pressure kPa
20 ± 1	63 to 67	86 to 106
23 ± 1	48 to 52	86 to 106
25 ± 1	48 to 52	86 to 106
27 ± 1	63 to 67	86 to 106

3.2.4 Reference conditions

For reference purposes, the standard atmospheric conditions for reference given in 5.1 of IEC 60068-1:1988 apply:

- temperature: 20 °C;
- air pressure: 101,3 kPa.

3.3 Drying

Unless otherwise specified in the relevant specification, the filter shall be conditioned for (96 ± 4) h by heating in a circulating air oven at a temperature of (55 ± 2) °C and a relative humidity not exceeding 20 %.

The filter shall then be allowed to cool in a desiccator using a suitable desiccant, such as activated alumina or silica gel, and shall be kept therein from the time of removal from the oven to the beginning of the specified tests.

3.4 Visual examination and check of dimensions

3.4.1 Visual examination

The condition, workmanship and finish shall be satisfactory, as checked by visual examination (see 2.2.15).

Marking shall be legible, as checked by visual examination. It shall conform to the requirements of the detail specification.

3.4.2 Dimensions (gauging)

The dimensions indicated in the detail specification as being suitable for gauging shall be checked, and shall comply with the values prescribed in the detail specification.

When applicable, measurements shall be made in accordance with IEC 60294.

3.4.3 Dimensions (detail)

All dimensions prescribed in the detail specification shall be checked and shall comply with the values prescribed.

3.4.4 Creepage distances and clearances

For those filters for which safety tests are appropriate, creepage distances and clearances on the outside of the filter between live parts of different polarity or between live parts and a metal case shall be not less than the appropriate values prescribed in the relevant specification.

3.5 Insulation resistance

For filters fitted with a discharge resistor or varistor, this measurement can only be made with the discharge resistor or varistor disconnected. If the discharge resistor cannot be disconnected without the filter being destroyed, the test shall be omitted for lot-by-lot tests; for qualification approval and periodic tests, where the discharge resistor cannot be disconnected without the filter being destroyed, the sample shall consist of filters specially made without discharge resistors.