IEC 60939-3

Edition 1.0 2015-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Passive filter units for electromagnetic interference suppression –
Part 3: Passive filter units for which safety tests are appropriate

Filtres passifs d'antiparasitage –
Partie 3: Filtres passifs pour lesquels des essais de sécurité sont appropriés

IEC 60939-3:2015-08(en-fr)

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PASSIVE FILTER UNITS FOR ELECTROMAGNETIC INTERFERENCE SUPPRESSION –

Part 3: Passive filter units for which safety tests are appropriate

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 60939-3 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

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

FDIS	Report on voting
40/2387/FDIS	40/2398A/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 in the IEC 60939 series, published 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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The contents of the corrigenda of April 2016 and May 2018 have been included in this copy.

PASSIVE FILTER UNITS FOR ELECTROMAGNETIC INTERFERENCE SUPPRESSION –

Part 3: Passive filter units for which safety tests are appropriate

1 General

1.1 Scope

This specification covers passive filters used to attenuate unwanted radio-frequency signals (such as noise or interference) generated from electromagnetic sources.

Both single and multi-channel filters within one enclosure or which are built on a printed circuit board forming a compact entity are included within the scope of this 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 specification. It is up to the manufacturer to state whether a given component is to be designed as a capacitor, an inductor or a filter. Filters can include also other components like resistors and/or varistors or similar components.

This specification applies to passive filter units for electromagnetic interference suppression for which safety tests are appropriate. This implies that filters specified according to this specification will either be connected to mains supplies, when compliance with the mandatory tests of Table 3 is necessary, or used in other circuit positions where the equipment specification prescribes that some or all of these safety tests are required.

This specification applies to passive filter units, which will be connected to an a.c. mains or other supply (d.c. or a.c.) with a nominal voltage not exceeding 1 000 V a.c., with a nominal frequency not exceeding 400 Hz, or 1 500 V d.c.

NOTE For a.c. use, IEC 60384-14 applies to capacitors which will be connected to a.c. mains with a nominal frequency not exceeding 100 Hz.

This specification covers appliance filters (US) but does not cover facility filters, cord-connected filters or direct plug-in filters. These other filters will be covered by another sectional specification.

1.2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 These documents are referenced, in whole, in part or as alternative requirements to the requirements contained in this standard. Their use is specified, where necessary, for the application of the requirements of this standard.

NOTE 2 The list below is a summary of all standards that are referred to within this standard. Appearance of a standard in the list does not mean that the standard or parts of it are applicable. Only those parts that are specifically referenced in this standard are applicable.

IEC 60027-1, *Letters symbols to be used in electrical technology – Part 1: General*

IEC 60050 (all parts), *International electrotechnical vocabulary*

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60062, *Marking codes 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 – 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 60068-2-14, *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 60068-2-20:2008, *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, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

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

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

IEC 60384-14:2013, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage system – Part 1: Principles, requirements and tests*

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

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60938-1:2006, *Fixed inductors for electromagnetic interference suppression – Part 1: Generic specification*

IEC 60938-2, *Fixed inductors for electromagnetic interference suppression – Part 2: Sectional specification*

IEC 60939-1, *Passive filter units for electromagnetic interference suppression – Part 1: Generic specification*

IEC 60940, *Guidance information on the application of capacitors, resistors, inductors and complete filter units for electromagnetic interference suppression*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

ISO 80000-1, *Quantities and units – Part 1: General*

CISPR 17, *Methods of measurement of the suppression characteristics of passive EMC filtering devices*

1.3 Information to be given in a detail specification

1.3.1 General

The detail specifications shall be derived from the relevant blank detail specification.

Detail specifications shall not specify requirements inferior to those of this specification or blank detail specification. When more severe requirements are included, they shall be listed in the detail specification, and indicated in the test schedules, for example by an asterisk.

The information outlined in 1.3.2 to 1.3.5 shall be given in each detail specification and the values quoted shall preferably be selected from the appropriate clause of this specification.

1.3.2 Outline drawing and dimensions

There shall be an illustration of the filter as an aid to easy recognition and for comparison of the filter with others. Dimensions and their associated tolerances, which affect interchange ability and mounting, shall be given in the detail specification. All dimensions shall preferably be stated in millimetres.

Normally, the numerical values shall be given for the length of the body, the width and height of the body and the wire spacing, or for cylindrical types, the body diameter and the length and diameter of the terminations. When necessary, for example when a range of filters is covered by a single detail specification, their dimensions and their associated tolerances shall be placed in a table following the drawing.

In addition, the detail specification shall state such other dimensional information as will adequately describe the filter outline.

Information given in 1.3.2 may, for convenience, be presented in tabular form.

1.3.3 Mounting

The detail specification shall specify the method of mounting recommended for normal use and the method which is mandatory for the application of the vibration, bump, shock and endurance tests. The design of the filter may be such that special mounting fixtures or heat sinks are required in its use. In this case, the detail specification shall describe the mounting fixtures and they shall be used in the application of the vibration, bump or shock tests. The specified heat sink shall be used in the application of the endurance test. If recommendations for mounting for "normal" use are made, they shall be included in the detail specification under "Additional information (not for inspection purposes)". If they are included, a warning can be given that the full vibration, bump and shock performance may not be available if mounting methods other than those specified in the detail specification are used.

1.3.4 Ratings and characteristics

1.3.4.1 Units, symbols and terminology

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

– IEC 60027-1
– IEC 60050 series
– ISO 80000-1

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

1.3.4.2 General

The ratings and characteristics shall be in accordance with the relevant clauses of this specification.

1.3.4.3 Particular characteristics

Additional characteristics may be listed when they are considered necessary to specify adequately the filter for design or application purposes.

1.3.5 Marking

The detail specification shall specify the content of the marking on the filter and the package.

1.4 Terms and definitions

For the purposes of this document, the applicable terms and definitions of IEC 60939-1 and the following apply.

1.4.1
capacitor of Class X
RC unit of Class X
capacitor or RC unit of a type suitable for use in situations where failure of the capacitor would not lead to danger of electric shock but could result in a risk of fire

Note 1 to entry: Class X capacitors are divided into two subclasses (see Table 1) according to the peak voltage of the impulses superimposed on the mains voltage to which they may be subjected in service. Such impulses may arise from lightning strikes on outside lines, from switching in neighbouring equipment, or switching in the equipment in which the capacitor is used.

Table 1 – Classification of Class X capacitors

Subclass	Peak impulse voltage in service	Application	Peak impulse voltage U_P applied before endurance test
X1	> 2,5 kV ≤ 4,0 kV	High pulse application	When $C_N \leq 1{,}0\ \mu F$ U_P = 4 kV
			When $C_N > 1{,}0\ \mu F$ $U_P = \dfrac{4}{\sqrt{\dfrac{C_N}{10^{-6}\ F}}}\ kV$
X2	≤ 2,5 kV	General purpose	When $C_N \leq 1{,}0\ \mu F$ U_P = 2,5 kV
			When $C_N > 1{,}0\ \mu F$ $U_P = \dfrac{2{,}5}{\sqrt{\dfrac{C_N}{10^{-6}\ F}}}\ kV$
X1 capacitors may be substituted by Y2 or Y1 capacitors of the same or higher U_R X2 capacitors can be substituted with X1, Y2 or Y1 capacitors of the same or higher U_R.			
NOTE 1 The factor used for the reduction of U_P for capacitance values above 1,0 µF maintains ½ × $C_N U_P^2$ constant for these capacitance values; C_N is in F. NOTE 2 Overvoltage categories in association with rated impulse voltage and rated mains voltage are found in IEC 60664-1.			

[SOURCE: IEC 60384-14:2013, 1.7.1 and Table 1]

1.4.2
capacitor of Class Y
RC unit of Class Y
capacitor or RC-unit of a type suitable for use in situations where failure of the capacitor could lead to danger of electric shock.

Note 1 to entry: Class Y capacitors are further divided into three subclasses Y1, Y2, and Y4, as shown in Table 2.

One Y-capacitor may bridge basic insulation. One Y-capacitor may bridge supplementary insulation. If combined basic and supplementary insulations are bridged by two Y2- or Y4-capacitors in series, they must have the same nominal value.

In a.c.-applications Y-capacitors can be substituted with two X-capacitors connected in series provided that U_R of the X-capacitors are not less than the U_R of the Y-capacitor and that the filter withstands the voltage proof in 4.8. In case of Y1-capacitor substitution, the X-capacitors shall be X1-capacitors.

In DC-filters with a rated voltage of 150 V d.c. or less, a Y2- and Y4-capacitor may be substituted by one X-capacitor with a rated voltage 250 V d.c. or higher.

For guidance on the application of capacitors bridging basic insulation, see IEC 60940.