

**Harmonized system of quality assessment
for electronic components**

**Sectional specification:
Passive filter units for
electromagnetic
interference
suppression(filters for
which safety tests are
required)**

The European Standard EN 133200:1999 has the status of a
British Standard

ICS 31.160; 33.100.10

National foreword

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The UK participation in its preparation was entrusted by Technical Committee EPL/40, Capacitors and resistors for electronic equipment, to Subcommittee EPL/40/1, Capacitors and EMI suppression components for electronic equipment, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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Passive filter units for electromagnetic interference suppression
(Filters for which safety tests are required)

Spécification intermédiaire:
Filtres passifs d'antiparasitage
(Filtres pour lesquels des essais
de sécurité sont exigés)

Rahmenspezifikation:
Passive Filter für die Unterdrückung
von elektromagnetischen Störungen
(Filter für die Sicherheitsprüfungen
vorgeschrieben sind)

This European Standard was approved by CENELEC on 1999-04-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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CENELEC

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FOREWORD

This European Standard was prepared by the Technical Committee CENELEC TC 40XA, Capacitors.

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1 - GENERAL

1.1 Scope

This specification applies to passive filter units for electromagnetic interference suppression which fall within the scope of the Generic Specification EN 133000.

The scope of this specification is restricted to passive filter units 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 2 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 with a nominal voltage not exceeding 1000 V a.c. (r.m.s.) or 1000 V d.c. with a nominal frequency not exceeding 400 Hz.

1.2 Related documents

EN 60320	series	Appliance couplers for household and similar general purposes
EN 60998-2-2	1993	Connecting devices for low voltage circuits for household and similar purposes -- Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units
EN 100114	1994	Rule of Procedure 14: Quality assessment procedures -- Part 1: Approval of manufacturers and other organizations
EN 130600		Sectional Specification: Fixed capacitors with ceramic dielectric, class 1
EN 130700		Sectional Specification: Fixed capacitors with ceramic dielectric, class 2
EN 132400:	1994	Sectional Specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains (Assessment level D)
EN 133000	1997	Generic Specification: Passive filter units for electromagnetic interference suppression
EN 133100	1998	Sectional Specification: Passive filter units for electromagnetic interference suppression - Filters for which safety tests are not required
EN 133201	1998	Blank Detail Specification: Passive filter units for electromagnetic interference suppression - Filters for which safety tests are required
EN 133221	1998	Blank Detail Specification: Passive filter units for electromagnetic interference suppression - Filters for which safety tests are required (safety tests only)
IEC 60060-1	1989	High-voltage test techniques -- Part 1: General definitions and test requirements
IEC 60062 A 1	1992 1988	Marking Codes for Resistors and Capacitors
IEC 60063 A 1 A 2	1963 1967 1977	Preferred number series for resistors and capacitors.
IEC 60068	series	Environmental testing
IEC 60085	1984	Thermal evaluation and classification of electrical insulation
IEC 60279	1969	Measurement of the winding resistance of an a.c. machine during operation at alternating voltage
IEC 60294	1969	Measurement of the dimensions of a cylindrical component having two axial terminations
IEC 60335-1	1976	Safety of household and similar electrical appliances -- Part 1: General requirements

IEC 60384-14	1993	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	1973	Sampling plans and procedures for inspection by attributes
IEC 60536	1976	Classification of electrical and electronic equipment with regard to protection against electric shock
IEC 60760	1989	Flat, quick-connect terminations
IEC 60938	1988	Fixed inductors for radio interference suppression
IEC 60939	1988	Complete filter units for radio interference suppression
IEC 60940	1988	Guidance information on the application of capacitors, resistors, inductors and complete filter units for radio interference suppression
IEC 61210	1993	Connecting devices - Flat quick-connect terminations for electrical copper conductors – Safety requirements
ISO 3	1973	Preferred Numbers - Series of preferred numbers

1.3 Information to be given in a detail specification

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

Detail specifications shall not specify requirements inferior to those of the generic, sectional or blank detail specification. When more severe requirements are included, they shall be listed in 1.9 of the detail specification, and indicated in the test schedules, for example by an asterisk.

NOTE - The information given in 1.3.1 may for convenience be presented in tabular form.

The following information shall be given in each detail specification and the values quoted shall preferably be selected from the appropriate clause of this sectional specification.

1.3.1 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 interchangeability 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.

1.3.2 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.

NOTE - If recommendations for mounting for "normal" use are made, they shall be included in the detail specification under 1.8 "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 1.1 of the detail specification are used.

1.3.3 Ratings and characteristics

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

1.3.3.1 Particular characteristics

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

1.3.4 Marking

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

1.4 Terminology

In addition to 2.2 of EN 133000 the following definitions apply:

1.4.1 A.C. mains filter (or mains filter)

A passive filter unit designed essentially for application with a power-frequency alternating voltage supplied from the mains.

1.4.2 Class X capacitor

A capacitor of a type suitable for use in situations where failure of the capacitor would not lead to danger of electric shock.

Class X capacitors are divided into three sub-classes (see Table 1A) 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 1A – Class X capacitor sub-classes

Sub-class	Peak pulse voltage in service	IEC 664 installation category	Application	Peak impulse voltage U_p ; applied before endurance test
X1	$> 2,5 \text{ kV}$ $\leq 4,0 \text{ kV}$	III	High pulse application	When $C_R \leq 1,0 \mu\text{F}$: $U_p = 4,0 \text{ kV}$ When $C_R > 1,0 \mu\text{F}$: $U_p = \frac{4}{\sqrt{C_R}} \text{ kV}$
X2	$\leq 2,5 \text{ kV}$	II	General purpose	When $C_R \leq 1,0 \mu\text{F}$: $U_p = 2,5 \text{ kV}$ When $C_R > 1,0 \mu\text{F}$: $U_p = \frac{2,5}{\sqrt{C_R}} \text{ kV}$
X3	$\leq 1,2 \text{ kV}$	-	General purpose	None
NOTE - C_R is in μF .				

1.4.3 Class Y capacitor

A 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 - This definition is identical with that in 1.5.4 of IEC 60384-14.

Class Y capacitors are further divided into four sub-classes Y1, Y2, Y3 and Y4, as shown in Table 1B.

Table 1B – Class Y capacitor sub-classes

Sub-class	Type of insulation bridged	Range of rated voltages	Peak impulse voltage before endurance test
Y1	Double insulation or reinforced insulation	$\leq 500\text{ V}$	8,0 kV
Y2	Basic insulation or supplementary insulation	$\geq 150\text{ V}$ $\leq 300\text{ V}$	5,0 kV
Y3		$\geq 150\text{ V}$ $\leq 250\text{ V}$	none
Y4		$< 150\text{ V}$	2,5 kV
NOTE - For definitions of basic, supplementary, double and reinforced Insulation see IEC 536 sub-clauses 2.1, 2.2, 2.3 and 2.4.			

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-, Y3- or Y4-capacitors in series, they must have the same nominal value.

1.4.4 Earth inductor

An inductor that forms part of the earth lead of a filter.

NOTE - Earth inductors incorporated in filters shall meet the requirements of the relevant specification(s). See also EN 138000, clause 2.2.18.

1.5 Marking

1.5.1 See 2.4 of EN 133000 with the following details:

The information given in the marking is normally selected from the following list; the relative importance of each item is indicated by its position in the list:

- Manufacturer's name or trademark
- Manufacturer's type designation or the type designation given in the detail specification
- Recognized approval mark
- Rated voltage and rated frequency
- Identification of terminations and/or circuit diagram
- Rated current
- Rated temperature
- Climatic category
- Year and month (or week) of manufacture (may be indicated by the code given in IEC 60062)
- Reference to the detail specification.

1.5.2 The filter unit shall be clearly marked with a) to e) above and with as many of the remaining markings as is considered necessary and space allows.

1.5.3 The package containing the filter(s) shall be clearly marked with all the information listed in 1.5.1. National approvals may be indicated by lettering as an alternative to the approval mark.

1.5.4 Any additional marking shall be so applied that no confusion can arise.

2 - PREFERRED RATINGS AND CHARACTERISTICS

2.1 Preferred characteristics

The values given in detail specifications should preferably be selected from the following:

2.1.1 Preferred climatic categories

The filters covered by this specification are classified into climatic categories according to the general rules given in IEC 60068-1.

The lower and upper category temperature and the duration of the damp heat, steady state test should be chosen from the following:

Lower category temperature: - 65 °C, - 55 °C, - 40 °C, - 25 °C or - 10 °C

Upper category temperature: + 70 °C, + 85 °C, + 100 °C, + 125 °C or + 155 °C

Duration of the damp heat, steady state test: 21 or 56 days.

The severities for the cold and dry heat tests are the lower and upper category temperatures respectively.

For guidance on the application of the categories described above, see IEC 60940.

2.2 Preferred values of ratings

2.2.1 Rated voltage (U_R)

The preferred values of rated voltage are:

115 V, 250 V, 400 V, 440 V, 500 V and 760 V.

NOTE 1 - Electromagnetic interference suppression filters shall be chosen to have a rated voltage equal to or greater than the nominal voltage of the supply system to which they are connected. The design of the filters should take into account the possibility that the voltage of the system may rise by up to 10 % above its nominal voltage.

NOTE 2- A star connect can be used for X-capacitors in cases where line to line nominal voltages exceed 500 V d.c. or a.c. (r.m.s.).

2.2.2 Category voltage (U_C)

The category voltage is equal to the rated voltage unless otherwise stated in the detail specification.

2.2.3 Rated temperature

The rated temperature shall not be less than + 40 °C.

2.2.4 Passive flammability

When specified the minimum category of passive flammability permitted is category C.

3 – QUALITY ASSESSMENT PROCEDURES

3.1 Primary stage of manufacture

See 3.2 of EN 133000.

3.2 Structurally similar filters

See 3.2 of EN 100114-1 and 3.4 of EN 133000.

In addition to these provisions, filters may be considered as structurally similar only when for their range of component values they have the same capacitor, inductor and resistor technologies and corresponding capacitive elements are of the same sub-class.

3.3 Certified records of released lots

The information required in 3.5.1 of EN 133000 shall be made available when prescribed in the detail specification and when requested by a customer. After the endurance test the parameters for which variables information is required are insertion loss change and insulation resistance.

3.4 Approval testing

3.4.1 Safety tests only approval

Table 2 and Annex B form a schedule limited to tests concerning safety only requirements. The schedule to be used for safety only approval will be on the basis of fixed sample sizes according to 3.4 of EN 133000 as given in 3.4.3 and Table 2 of this specification. Prior to the approval testing being carried out it is necessary to submit to the certification body a declaration of design (Annex E) registering essential data and basic design details of the passive filters for which approval is sought.

The requalification of an approved filter is not required if one or more capacitors and/or inductors of the approved filter are substituted by capacitors and/or inductors having the same rated values provided they are certified to EN 132400/EN 138100.

3.4.2 Qualification approval

Table 3, 4 and 5 are to be used when qualification approval is sought.

The procedures for qualification approval testing are given in 3.5 of the Generic Specification EN 133000. The schedule to be used for qualification approval testing on the basis of lot-by-lot and periodic tests is given in sub-clause 3.5 and Tables 4 and 5 of this specification. The procedure using a fixed sample size schedule is given in 3.4.3 and Table 3 below. For the two procedures the sample sizes and the number of non-conforming items shall be of comparable order. The test conditions and requirements shall be the same. Qualification approval according to the fixed sample sizes of Table 3 is preferred.

3.4.3 Sampling

Filter types to be qualified together shall have the same rated voltage, and combination of component technologies; in addition the corresponding capacitive elements shall be of the same sub-class. The numbers of filters required for each qualification in each group are given in Tables 2 and 3.

For each qualification the sample shall contain equal numbers of specimens of the highest and lowest total capacitance values in the range to be qualified. Where only one total capacitance value is involved, the total number of filters as stated in Tables 2 and 3 shall be tested.

If for a given value of total capacitance there is more than one rated current available in the range, then filters with the highest rated current shall be chosen. If at this rated current more than one inductance value is available in the range, then filters with the highest inductance value shall be chosen.

NOTE - "Total capacitance" in the clause above means the capacitance between the input terminations of the filter.

Spare specimens are permitted as follows:

- One per value which may be used to replace the non-conforming item in Group 0.
- One per value which may be used as replacements for non-conforming specimens because of incidents not attributable to the manufacturer.

c) Sufficient specimens to enable the repeat test of note 8 to Tables 2 and 3 to be carried out.

The numbers given in Group 0 assume that all further groups are applicable. If this is not so, the numbers may be reduced accordingly. The numbers given in Group 0 may also be reduced if, for example for expensive filters, the manufacturer chooses to carry out the tests of a number of groups in sequence on the same specimens. The numbers given for Group 0 do not include the specimens required for Groups 7 and 8.

When additional groups are introduced into the qualification approval test schedule, the number of specimens required for Group 0 shall be increased by the same number as that required for the additional groups.

Table 2 or 3 gives the number of specimens to be tested in each group together with the permissible number of non-conforming for qualification approval tests.

3.4.4 Tests

Before submission to qualification approval testing an appropriate 100 % voltage proof test between terminations according to Table 7 shall be made. The details of this test are the prerogative of the manufacturer, but the time shall not be less than 1 s. If a d.c. test voltage is used instead of a.c. for filters containing class Y capacitors and the time is less than 2 s, it shall not be less than 1,8 times the a.c. test voltage in Table 7. All non-conforming items shall be removed from the lot prior to qualification approval testing.

One or more of the complete series of tests indicated in Table 2 or Table 3 may be required for the approval of filters covered by one detail specification. The tests of each group shall be carried out in the order given.

The whole sample with the exception of those specimens to be submitted to the tests of Groups 7 and 8 shall be subjected to the tests of Group 0 and then subdivided for the other groups.

A specimen found to be defective during the tests of Group 0 shall not be used for the other groups.

"One defective" is counted when a filter has not satisfied the whole or part of the tests of a group.

The approval is granted when the number of non-conforming items does not exceed the specified number of permissible non-conforming items for each group and the total number of permissible non-conforming items.

NOTE - Table 2 and Annex B or Table 3 and Annex A form the fixed sample size test schedule, where Table 2 or Table 3 includes the details for the sampling and permissible defectives for the different tests or groups of tests, whereas Annex A and Annex B together with the details of test contained in Section Four give a complete summary of the test conditions and performance requirements and indicate where for test methods or conditions of test a choice has to be made in the detail specification.

The conditions of test and performance requirements for the fixed sample size schedule shall be identical to those prescribed in the detail specification for the quality conformance inspection.

3.5 Quality conformance inspection

Before submission to the quality conformance inspection an appropriate 100% voltage proof test between terminations according to Table 7 shall be made. The details of this test are the prerogative of the manufacturer, but the time shall not be less than 1 s. If a d.c. test voltage is used instead of a.c. for filters containing class Y capacitors and the time is less than 2 s, it shall not be less than 1,8 times the a.c. test voltage in Table 7. All non-conforming items shall be removed from the lot prior to lot-by-lot testing.

3.5.1 Formation of inspection lots

a) Groups A and B inspection

These tests shall be carried out on a lot-by-lot basis using sampling plans appropriate to the given assessment level specified in Table 4 A and 4 B.

Manufactured lots of separately identified filter units may be aggregated into inspection lots formed for such tests as are relevant to structural similarities between those manufactured lots.

b) Group C inspection

These tests shall be carried out on a periodic basis.

Qualification approval

These tests shall be carried out on the number of specimens appropriate to the given assessment level specified in Table 5. In order to reduce the number of specimens required to carry out any single complete

periodic test, the manufacturer may elect to have the tests of more than one group carried out sequentially on the same specimens. The specimens shall be representative of the filters manufactured during each period. In subsequent periods other filters in the approved range in production shall be tested with the aim of covering the whole range of the approval.

c) Safety tests only approval

Requalification tests according to Annex B may be required by the certification body when a change of the declared design as given in Annex E is intended.

The certification body will be informed about the intended change(s) and decide whether requalification tests have to be performed.

3.5.2 Test Schedule

- Safety tests only approval
The schedule for the lot-by-lot tests and criteria for requalification are given in Section 2, Annex A and B of the blank detail specification EN 133221.
- Qualification approval
The schedule for the lot-by-lot and periodic tests for quality conformance inspection is given in Section 2, Table 4 of the blank detail specification EN 133201.

3.5.3 Delayed delivery

When according to the procedures in 3.10 of EN 133000, re-inspection has to be made, insulation resistance shall be checked as specified in Group A inspection and solderability shall be checked according to Group B inspection.

Table 2 - Tests concerning safety requirements only

Group	Sub-clauses And Tests	Number of specimens tested per qualification 4)	Number of non-conforming items per qualification	
			per group ⁸⁾	total
0	4.1 Visual examination	20 / 10 / 5	1 / 1 / 0	XXXX
	4.4 D.C. line resistance			XXXX
	4.5 Insertion loss (no load)			XXXX
	4.2 Voltage proof			XXXX
	4.3 Insulation resistance			XXXX
	4.6 Shunt resistance ¹⁾			XXXX
	Spares	5 / 3 / 2	XXXX	
1A	4.1.1 Creepage distances and clearances 4.7 Robustness of terminations ¹⁾ 4.8 Resistance to soldering heat ¹⁾ 4.23 Solvent resistance of the marking ²⁾	4 / 2 / 1	0	0
2	4.16 Damp heat, steady state	4 / 2 / 1	0	
3A	4.17 Temperature rise or ⁵⁾ 4.19.1 Endurance current ⁶⁾⁷⁾	4 / 2 / 1	0	
3B	4.18 Impulse voltage ^{10) 11)} 4.19.2 Endurance - voltage line terminations/case ¹⁾	4 / 2 / 1	0	
3C	4.18 Impulse voltage ^{10) 11)} 4.19.3 Endurance voltage between line terminations ⁷⁾	4 / 2 / 1	0	
7	4.21 Passive flammability ²⁾	see 4.21	0	
NOTES - see end of table 5				