

INTERNATIONAL STANDARD

IEC 60384-21

First edition
2004-06

Fixed capacitors for use in electronic equipment –

Part 21:

Sectional specification:

**Fixed surface mount multilayer capacitors
of ceramic dielectric, Class 1**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

**Part 21: Sectional specification:
Fixed surface mount multilayer capacitors
of ceramic dielectric, Class 1**

FOREWORD

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International Standard IEC 60384-21 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This standard and its related publications (CEI 60384-21-1, IEC 60384-22 and IEC 60384-22-1) cancel and replace IEC 60384-10 (1989) and its Amendments 1 (1993) and 2 (2000) as well as IEC 60384-10-1 (1989) and its Amendment 1 (1993).

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

FDIS	Report on voting
40/1420/FDIS	40/1451/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.

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- withdrawn;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.

A bilingual version of this standard may be issued at a later date.

The contents of the corrigendum of September 2004 have been included in this copy.

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FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 21: Sectional specification: Fixed surface mount multilayer capacitors of ceramic dielectric, Class 1

1 General

1.1 Scope

This sectional specification is applicable to fixed unencapsulated surface mount multilayer capacitors of ceramic dielectric, Class 1, for use in electronic equipment. These capacitors have metallized connecting pads or soldering strips and are intended to be mounted on printed boards, or directly onto substrates for hybrid circuits.

Capacitors for electromagnetic interference suppression are not included, but are covered by IEC 60384-14.

1.2 Object

The object of this standard is to prescribe preferred ratings and characteristics and to select from IEC 60384-1:1999 the appropriate quality assessment procedures, tests and measuring methods and to give general performance requirements for this type of capacitor. Test severities and requirements prescribed in detail specifications referring to this sectional specification shall be of equal or higher performance level, lower performance levels are not permitted.

1.3 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 60063:1963, *Preferred number series for resistors and capacitors*
Amendment 1 (1967)
Amendment 2 (1977)

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-58:1999, *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 60384-1:1999, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

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

ISO 3 :1973, *Preferred numbers – Series of preferred numbers*

1.4 Information to be given in a detail specification

Detail specification 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 1.4.1 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 those given in the appropriate Clause of this sectional specification.

1.4.1 Outline drawing and dimensions

There shall be an illustration of the capacitors as an aid to easy recognition and for comparison of the capacitors 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, however, when the original dimensions are given in inches, the converted metric dimensions in millimetres shall be added.

Normally the numerical values shall be given for the length, width and height of the body. When necessary, for example when a number of items (sizes and capacitance/voltage ranges) are covered by a detail specification, the dimensions and their associated tolerances shall be placed in a table below the drawing.

When the configuration is other than described above, the detail specification shall state such dimensional information as will adequately describe the capacitors.

1.4.2 Mounting

The detail specification shall give guidance on methods of mounting for normal use. Mounting for test and measurement purposes (when required) shall be in accordance with 4.3 of this sectional specification.

1.4.3 Rating and characteristics

The ratings and characteristics shall be in accordance with the relevant Clauses of this specification, together with the following:

1.4.3.1 Rated capacitance range

See 2.2.4.1

NOTE When products approved to the detail specification have different ranges, the following statement should be added: "The range of capacitance values available in each voltage range is given in IECQ 001005".

1.4.3.2 Particular characteristics

Additional characteristics may be listed, when they are considered necessary to specify adequately the component for design and application purposes.

1.4.3.3 Soldering

The detail specification shall prescribe the test methods, severities and requirements applicable for the solderability and the resistance to soldering heat tests.

1.4.4 Marking

The detail specification shall specify the content of the marking on the capacitor and on the package. Deviations from 1.6 of this sectional specification shall be specifically stated.

1.5 Terms and definitions

For the purposes of this sectional specification, the terms and definitions given in IEC 60384-1, as well as the following apply.

1.5.1

surface mount capacitor

a capacitor whose small dimensions and nature or shape of terminations make it suitable for surface mounting in hybrid circuits and on printed boards

1.5.2

fixed capacitors, ceramic dielectric, Class 1

a capacitor specially designed and suited for resonant circuit application where low losses and high stability of capacitance are essential or where a precisely defined temperature coefficient is required, for example for compensating temperature effects in the circuit.

The ceramic dielectric is defined by its rated temperature coefficient (α)

1.5.3

subclass

for a given rated temperature coefficient, the subclass is defined by the rated tolerance on the temperature coefficient (see Table 2)

NOTE The rated temperature coefficient value and its tolerance refer to the temperature interval of +20 °C to +85 °C, but because in practice TC curves are not strictly linear, it is necessary to define limiting capacitance deviation ($\Delta C/C$) for other temperatures (see Table 3)

1.5.4

category temperature range

range of ambient temperatures for which the capacitor has been designed to operate continuously; this is given by the lower and upper category temperature

1.5.5

rated temperature

maximum ambient temperature at which the rated voltage may be continuously applied

1.5.6

rated voltage (d.c.)

U_R

maximum direct voltage or peak value of pulse voltage which may be applied continuously to a capacitor at any temperature between the lower category temperature and the rated temperature

NOTE The sum of the d.c. voltage and the peak a.c. voltage or the peak to peak a.c. voltage, whichever is the greater, applied to the capacitor shall not exceed the rated voltage. The value of the peak a.c. voltage shall not exceed the value determined by the permissible reactive power.

1.5.7

category voltage

U_C

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

1.6 Marking

See 2.4 of IEC 60384-1 with the following details:

1.6.1 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:

- a) rated capacitance;
- b) rated voltage (d.c. voltage may be indicated by the symbol $\overline{\quad}$ or $\underline{\quad}$);
- c) tolerance on rated capacitance;
- d) temperature coefficient and its tolerance as applicable (according to 2.2.5);
- e) year and month (or week) of manufacture;
- f) manufacturer's name or trade mark;
- g) climatic category;
- h) manufacturer's type designation;
- i) reference to the detail specification.

1.6.2 These capacitors are generally not marked on the body. If some marking can be applied, they shall be clearly marked with as many as possible of the above items as is considered useful. Any duplication of information in the marking on the capacitor should be avoided.

1.6.3 Any marking shall be legible and not easily smeared or removed by rubbing with the finger.

1.6.4 The package containing the capacitor(s) shall be clearly marked with all the information listed in 1.6.1.

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

2 Preferred rating and characteristics

2.1 Preferred characteristics

The values given in the detail specification shall preferably be selected from the following:

2.1.1 Preferred climatic categories

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

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

Lower category temperature: $-55\text{ }^{\circ}\text{C}$, $-40\text{ }^{\circ}\text{C}$, $-25\text{ }^{\circ}\text{C}$, $-10\text{ }^{\circ}\text{C}$ and $+10\text{ }^{\circ}\text{C}$

Upper category temperature: $+70\text{ }^{\circ}\text{C}$, $+85\text{ }^{\circ}\text{C}$, $+100\text{ }^{\circ}\text{C}$, $+125\text{ }^{\circ}\text{C}$ and $+150\text{ }^{\circ}\text{C}$

Duration of the damp heat, steady state test: 4, 10, 21 and 56 days.

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

NOTE The resistance to humidity resulting from the above climatic category is for the capacitors in their unmounted state. The climatic performance of the capacitors after mounting is greatly influenced by the mounting substrate, the mounting method (see 4.3) and the final coating.

2.2 Preferred values of ratings

2.2.1 Rated temperature

For capacitors covered by this sectional specification, the rated temperature is equal to the upper category temperature, unless the upper category temperature exceeds 125 °C.

2.2.2 Rated voltage (U_R)

The preferred values of the rated voltage are the values of the R5 series of ISO 3. If other values are needed they shall be chosen from the R10 series.

2.2.3 Category voltage (U_C)

When the rated temperature is defined as the upper category temperature, the category voltage is equal to the rated voltage as defined in IEC 60384-1, 2.2.17. If the upper category temperature exceeds 125 °C, or the rated voltages exceed 500 V, the category voltage shall be given in the detail specification.

2.2.4 Preferred values of rated capacitance and associated tolerance values

2.2.4.1 Preferred values of rated capacitance

Rated capacitance values shall be taken from the series of IEC 60063; the E6, E12 and E24 series are preferred.

2.2.4.2 Preferred tolerance on rated capacitance

See Table 1.

Table 1 – Preferred tolerance on rated capacitance

Preferred series	Tolerance			
	$C_R \geq 10 \text{ pF}$	Letter code	$C_R < 10 \text{ pF}$	Letter code
E 6	$\pm 20 \%$	M	$\pm 2 \text{ pF}$	G
E 12	$\pm 10 \%$	K	$\pm 1 \text{ pF}$	F
E 24	$\pm 5 \%$	J	$\pm 0.5 \text{ pF}$	D
	$\pm 2 \%$	G	$\pm 0.25 \text{ pF}$	C
	$\pm 1 \%$	F	$\pm 0.1 \text{ pF}$	B

2.2.5 Temperature coefficient (α)

2.2.5.1 Table 2 shows the preferred rated temperature coefficients and the associated tolerances, expressed in parts per million per degree Kelvin ($10^{-6}/K$), and the corresponding subclasses and codes.

The detail specification shall specify for each temperature coefficient the minimum value of capacitance for which the given tolerance of temperature coefficient may be verified, considering the accuracy of the method of capacitance measurement specified.

For values of capacitance lower than this minimum value:

- a) The detail specification shall specify a multiplying factor for the tolerance on α , as well as the permissible changes of capacitance at the lower and upper category temperature.