

# INTERNATIONAL STANDARD



**Fixed capacitors for use in electronic equipment –  
Part 22: Sectional specification – Fixed surface mount multilayer capacitors of  
ceramic dielectric, Class 2**

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**FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –****Part 22: Sectional specification –  
Fixed surface mount multilayer capacitors of ceramic dielectric, Class 2**

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**This commented version (CMV) of the official standard IEC 60384-22:2024 edition 4.0 allows the user to identify the changes made to the previous IEC 60384-22:2019 edition 3.0. Furthermore, comments from IEC TC 40 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.**

**A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.**

**This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.**



IEC 60384-22 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2019. This edition constitutes a technical revision.

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

- a) the document has been completely restructured to comply with the ISO/IEC Directives, Part 2 and to make it more useable; tables, figures and references have been revised accordingly; Annex X contains all cross-references of changes in clause/subclause numbers;
- b) the requirements of reference temperature 25 °C has been added in Table 5, Table 9, Table 10, Table 12, Table 14 and Table 17;
- c) the table of temperature characteristics of capacitance for the reference temperature 25 °C have been added in Table C.1, Table C.2 and Table C.3;
- d) the requirement in 5.5.2 (visual examination) has been repeated in 5.9.3, 5.10.6, 5.11.4, 5.12.6, 5.13.8, 5.14.6 and 5.15.6;
- e) the deflection D in the very robust designs has been added in 5.9.1;
- f) Annex C has been changed informative into normative;
- g) Clause D.5 (Test schedule for quality conformance inspection) has been newly added to withdraw the blank detail specification: IEC 60384-22-1.

The text of this International Standard is based on the following documents:

Draft	Report on voting
40/3120/FDIS	40/3139/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

A list of all parts in the IEC 60384 series, published under the general title *Fixed capacitors for use in electronic equipment*, can be found on the IEC website.

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# FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

## Part 22: Sectional specification – Fixed surface mount multilayer capacitors of ceramic dielectric, Class 2

### 1 Scope

This part of IEC 60384 is applicable to fixed unencapsulated surface mount multilayer capacitors of ceramic dielectric, Class 2, 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.

The object of this document is to ~~prescribe~~ specify preferred ratings and characteristics and to select from IEC 60384-1:2021 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 are of equal or higher performance levels; lower performance levels are not permitted.~~ Test severities and requirements specified in detail specifications referring to this document provide specific test severities and requirements of an equal or higher performance level. Further information on the conception of generic, sectional and detail specifications can be found in the Introduction of IEC 60384-1:2021. **1**

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, Preferred number series for resistors and capacitors~~

~~IEC 60068-1:2013, Environmental testing – Part 1: General and guidance~~

IEC 60068-2-58:2015, *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 60068-2-58:2015/AMD1:2017~~

IEC 60384-1:2016/2021, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 61193-2:2007, *Quality assessment system – Part 2: Selection and use of sampling plans for inspection of electronic components and packages*

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

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60384-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

#### 3.1

##### **surface mount multilayer capacitor**

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

#### 3.2

##### **capacitor of ceramic dielectric, Class 2**

capacitor that has a dielectric with a high permittivity and is suitable for by-pass and coupling applications or for frequency-discriminating circuits where low losses and high stability of capacitance are not of major importance

Note 1 to entry: The ceramic dielectric is characterized by a non-linear change of capacitance over the category temperature range (see Table 3).

#### 3.3

##### **subclass**

<Class 2> maximum percentage change of capacitance within the category temperature range with respect to the capacitance at the reference temperature 20 °C or 25 °C

Note 1 to entry: The subclass may be expressed in code form (see Table 3 and Annex C).

#### 3.4

##### **category temperature range**

ambient temperature range for which the capacitor has been designed to operate continuously

Note 1 to entry: This is given by the lower and upper category temperature (see Table 3 and Annex C).

#### 3.5

##### **rated temperature**

$T_R$

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

#### 3.6

##### **rated voltage**

$U_R$

maximum DC voltage that ~~may~~ can be applied continuously to a capacitor at any temperature between the lower category temperature and the rated temperature

Note 1 to entry: The maximum DC voltage is the sum of the DC voltage and peak AC voltage or peak pulse voltage applied to the capacitor.

#### 3.7

##### **category voltage**

$U_C$

maximum voltage that can be applied continuously to a capacitor at its upper category temperature

## 4 Preferred ratings and characteristics

### 4.1 Preferred characteristics

Preferred climatic categories only shall be given in the preferred characteristics.

The capacitors covered by this document are classified into climatic categories in accordance with the general rules given in IEC 60068-1:2013, Annex A.

For reference temperature 20 °C, 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 °C, –40 °C, –25 °C, –10 °C and +10 °C;
- upper category temperature: +70 °C, +85 °C, +100 °C, +125 °C and +150 °C;
- duration of the damp heat, steady state test (40 °C, 93 % RH): 4, 10, 21 and 56 days.

For reference temperature 25 °C, the lower and upper category temperatures shall be chosen from Table C.1 in Annex C. **2**

The severities of 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 5.4) and the final coating.

### 4.2 Preferred values of ratings

#### 4.2.1 Rated temperature ( $T_R$ )

The rated temperature is equal to the upper category temperature for capacitors with the upper category temperature not exceeding 125 °C, unless otherwise stated in the detail specification.

#### 4.2.2 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.

The sum of the DC voltage and the peak AC voltage or the peak-to-peak AC voltage, whichever is the greater, applied to the capacitor shall not exceed the rated voltage.

#### 4.2.3 Category voltage ( $U_C$ )

The category voltage is equal to the rated voltage for capacitors with the upper category temperature not exceeding 125 °C. Any category voltages which are different from the rated voltage, for capacitors with the upper category temperature exceeding 125 °C or for high-voltage capacitors with rated voltages about 500 V, shall be given in the detail specification.

The preferred values of the category voltage at 125 °C upper category temperature for high volumetric capacitors with a rated voltage of 16 V and less and a rated temperature of 85 °C are given in Table 1.

**Table 1 – Preferred values of category voltages**

$U_R$	V	2,5	4	6,3	10	16
$U_C$	V	1,6	2,5	4	6,3	10
NOTE The numeric values of $U_C$ are calculated by the following: $U_C = 0,63 \times U_R$						

**4.2.4 Preferred values of nominal capacitance and associated tolerance values**

**4.2.4.1 Preferred values of nominal capacitance**

Nominal capacitance values ~~shall~~ should be taken from ~~the number series of IEC 60063~~; the E3, E6 and E12 series ~~are preferred~~ given in IEC 60063.

**4.2.4.2 Preferred tolerances on nominal capacitance**

See Table 2.

**Table 2 – Preferred tolerances**

Preferred series	Tolerance %	Letter code
E3 and E6	-20/+80	Z
	-20/+50	S
E6	± 20	M
E6 and E12	± 10	K

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**4.2.5 Temperature characteristic of capacitance**

Table 3 ~~denotes with a cross the preferred values of~~ shows the temperature characteristic with and without DC voltage applied for the reference temperature 20 °C. The method of coding the subclass is also given; for example a dielectric with a percentage change of ±20 % without DC voltage applied over the temperature range from -55 °C to +125 °C will be defined as a dielectric of subclass 2C1. The temperature characteristics, category temperatures and corresponding codes for the reference temperature 25 °C are given in Annex C. The temperature range for which the temperature characteristic of the dielectric is defined is the same as the category temperature range.