

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Fixed capacitors for use in electronic equipment –
Part 8: Sectional specification – Fixed capacitors of ceramic dielectric, Class 1**

**Condensateurs fixes utilisés dans les équipements électroniques –
Partie 8: Spécification intermédiaire – Condensateurs fixes à diélectrique en
céramique, Classe 1**

[IEC 60384-8:2024](#)

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ELECTROTECHNICAL
COMMISSION

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INTERNATIONALE

ICS 31.060.20

ISBN 978-2-8322-9520-5

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –**Part 8: Sectional specification –
Fixed capacitors of ceramic dielectric, Class 1**

FOREWORD

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IEC 60384-8 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2015. 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 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- b) The terms have been replaced by the letter symbols in Table 3.

- c) Code of temperature coefficient and tolerance of C0G, U2J have been added in Table 4, Table 6, Table 8, Table 9, Table 11, Table 13, Table 16 and Annex B.
- d) Annex B has been changed from informative to normative.
- e) Clause C.5 (Test schedule for quality conformance inspection) has been newly added to withdraw the blank detail specification: IEC 60384-8-1.

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

Draft	Report on voting
40/3144/FDIS	40/3161/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. The main document types developed by IEC are described in greater detail at 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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 8: Sectional specification – Fixed capacitors of ceramic dielectric, Class 1

1 Scope

This part of IEC 60384 is applicable to fixed capacitors of ceramic dielectric with a defined temperature coefficient (dielectric Class 1), intended for use in electronic equipment, including leadless capacitors but excluding fixed surface mount multilayer capacitors of ceramic dielectric, which are covered by IEC 60384-21 (Class 1).

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

The object of this document is to 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 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.

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

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

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 capacitor of ceramic dielectric, Class 1

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

Note 1 to entry: The ceramic dielectric is defined by its nominal temperature coefficient (α).

3.2 subclass

<Class 1> tolerance on the temperature coefficient for a given nominal temperature coefficient (see Table 2)

Note 1 to entry: The nominal temperature coefficient value and its tolerance refer to the temperature interval of +20 °C or +25 °C to +85 °C but because in practice TC curves are not strictly linear, it is necessary to define limiting capacitance deviations ($\Delta C/C$) for other temperatures (see Table 3 and Annex B). The same information is expressed in graphical form in Figure A.1 to Figure A.15.

Figure A.1 to Figure A.15 enable the user to form an estimate of the value and tolerance of $1/C \times (dC/dT)_T$, the incremental temperature coefficient at a given temperature T , though this quantity is not required specifically to be measured in the test.

3.3 rated voltage

U_R

maximum DC voltage that can be applied continuously to the terminations of a capacitor at the rated temperature

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

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

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

4.2 Preferred values of ratings

4.2.1 Rated temperature

For capacitors covered by this document, the rated temperature is equal to the upper category temperature.

4.2.2 Rated voltage (U_R)

The preferred values of rated voltage are: (25, 40, 63, 100, 160, 250, 400, 630, 1 000, 1 600, 2 500, 4 000 and 6 300) V. These values conform to the basic series of preferred values R5 given in 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 applied to the capacitor shall not exceed the rated voltage.

4.2.3 Category voltage (U_C)

Since the rated temperature is defined as the upper category temperature, the category voltage is equal to the rated voltage, as defined in IEC 60384-1:2021, 3.5.

4.2.4 Preferred values of nominal capacitance and associated tolerance values

4.2.4.1 Preferred values of nominal capacitance

Nominal capacitance values should be taken from the E6, E12 and E24 series given in IEC 60063.

4.2.4.2 Preferred tolerances on nominal capacitance

Table 1 denotes the preferred values of tolerance on nominal capacitance.

Table 1 – Preferred tolerances on nominal capacitance

Preferred series	$C_N \geq 10 \text{ pF}$		$C_N < 10 \text{ pF}$	
	Tolerances	Letter code	Tolerances	Letter code
E 6	$\pm 20 \%$	M	$\pm 2 \text{ pF}$	G
E 12	$\pm 10 \%$	K	$\pm 1 \text{ pF}$	F
	$\pm 5 \%$	J	$\pm 0,5 \text{ pF}$	D
E 24	$\pm 2 \%$	G	$\pm 0,25 \text{ pF}$	C
	$\pm 1 \%$	F	$\pm 0,1 \text{ pF}$	B

4.2.5 Temperature coefficient (α)

4.2.5.1 Nominal temperature coefficient and tolerance

Table 2 shows the nominal temperature coefficients for the reference temperature 20 °C and the associated tolerances, expressed in parts per million per Kelvin ($10^{-6}/K$), and the corresponding subclasses and codes. Annex B contains the most used temperature coefficients for the reference temperature 25 °C.

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 methods of capacitance measurement specified.

For values of capacitance lower than these minimum values:

- 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;
- b) Special methods of measurement can be necessary and, if required, shall be stated in the detail specification.

**Table 2 – Nominal temperature coefficient and tolerance
for reference temperature 20 °C**

Nominal temperature coefficient (α) $10^{-6}/K$	Tolerance on temperature coefficient $10^{-6}/K$	Subclass	Letter code		Colour code for temperature coefficient
			α	Tolerance	
+100	± 15 ± 30	1A 1B	A	F G	Red and Violet
0	± 15 ± 30 ± 60	1A 1B 1F	C	F G H	Black
-33	± 15 ± 30	1A 1B	H	F G	Brown
-75	± 15 ± 30	1A 1B	L	F G	Red
-150	± 15 ± 30 ± 60	1A 1B 1F	P	F G H	Orange
-220	± 15 ± 30 ± 60	1A 1B 1F	R	F G H	Yellow
-330	± 30 ± 60	1A 1B	S	G H	Green
-470	± 30 ± 60	1A 1B	T	G H	Blue
-750	± 60 ± 120 ± 250	1A 1B 1F	U	H J K	Violet
-1 000	± 60 ± 120 ± 250	1A 1B 1F	Q	H J K	Red and Yellow
-1 500	± 250	1F	V	K	Orange and Orange
-2 200	± 500	1F	K	L	Yellow and Orange
-3 300	± 500	1F	D	L	Green and Orange
-4 700	$\pm 1\ 000$	1F	E	M	Blue and Orange
-5 600	$\pm 1\ 000$	1F	F	M	Black and Orange
+140 $\geq \alpha \geq$ -1 000	^a	1C	SL	-	Grey
+250 $\geq \alpha \geq$ -1 750	^a	1D	UM	-	White

α values +33 $\times 10^{-6}/K$ and -47 $\times 10^{-6}/K$ are also obtained on request.

The nominal temperature coefficients and their tolerances are defined using the capacitance change between the temperatures 20 °C and 85 °C.

A capacitor with a temperature coefficient of 0 $\times 10^{-6}/K$ and a tolerance on temperature coefficient of $\pm 30 \times 10^{-6}/K$ is designated as a CG capacitor (subclass 1B).

^a Those temperature coefficient values are not subject to inspection, since no limits for relative capacitance variation are specified in Table 3.

4.2.5.2 Permissible relative variation of capacitance

Table 3 shows for each combination of temperature coefficient and tolerance the permissible relative variation of capacitance expressed in parts per thousand at both the upper and lower category temperatures. Temperature coefficients and tolerances are expressed in parts per million per Kelvin ($10^{-6}/K$). In the case of reference temperature 25 °C, see Table B.1 for an explanation of the permissible relative variation of capacitance.

Figure A.1 to Figure A.15 show the limits of variation of capacitance with temperature for the temperature coefficients and subclasses listed in Table 3.

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