SLOVENSKI STANDARD
oSIST prEN IEC 60384-8:2023

01-oktober-2023

Pritrjeni kondenzatorji za uporabo v elektronski opremi - 8. del: Področna specifikacija: pritrjeni kondenzatorji s keramičnim dielektrikom, razred 1

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

Festkondensatoren zur Verwendung in Geräten der Elektronik - Teil 8: Rahmenspezifikation - Keramik-Festkondensatoren, Klasse 1

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

Ta slovenski standard je istoveten z: **prEN IEC 60384-8:2023**

ICS:

31.060.10	Fiksni kondenzatorji	Fixed capacitors
31.060.20	Keramični kondenzatorji in sljudni kondenzatorji	Ceramic and mica capacitors

oSIST prEN IEC 60384-8:2023 **en**

40/3068/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER:	
IEC 60384-8 ED5	
DATE OF CIRCULATION:	CLOSING DATE FOR VOTING:
2023-08-25	**2023-11-17**
SUPERSEDES DOCUMENTS:	
40/3009/CD, 40/3051/CC	

IEC TC 40 : CAPACITORS AND RESISTORS FOR ELECTRONIC EQUIPMENT	
SECRETARIAT: Netherlands	SECRETARY: Mr Ronald Drenthen
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING **Attention IEC-CENELEC parallel voting** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE:

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

PROPOSED STABILITY DATE: 2032

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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 the ISO/IEC Directives, Part 2 and to make it more useable; tables, figures and references have been revised accordingly.

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 informative into normative.

e) 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
XX/XX/FDIS	XX/XX/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 https://www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at https://www.iec.ch/standardsdev/publications.

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

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

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 standard 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 sectional specification provide specific test severities and requirements of an equal or higher performance level. For further information on the conception of generic, sectional and detail specifications, see IEC 60384-1:2021, INTRODUCTION.

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 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*

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 60384-1:2021 and the following apply.

ISO and IEC maintain terminological 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
fixed capacitors, 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
for a given nominal temperature coefficient; it is defined by the tolerance on the 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 Figures A.1 to A.15.

These figures 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 standard 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, 10, 21 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 standard, 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

	$C_N \geq 10$ pF		$C_N < 10$ pF	
Preferred series	**Tolerances**	**Letter code**	**Tolerances**	**Letter code**
E 6	±20 %	M	±2 pF	G
E 12	±10 % ±5 %	K J	±1 pF ±0,5 pF	F D
E 24	±2 % ±1 %	G F	±0,25 pF ±0,1 pF	C 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 may be necessary and, if required, shall be stated in the detail specification.

c) Permissible relative variation of capacitance

Table 2 – Nominal temperature coefficient and tolerances (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 + 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 + Yellow
–1 500	±250	1F	V	K	Orange + Orange
–2 200	±500	1F	K	L	Yellow + Orange
–3 300	±500	1F	D	L	Green + Orange
–4 700	±1 000	1F	E	M	Blue + Orange
–5 600	±1 000	1F	F	M	Black + Orange
+140≥α≥–1 000	[a]	1C	SL	-	Grey
+250≥α ≥–1 750	[a]	1D	UM	-	White

NOTE 1 α values +33 × 10^{-6}/K and -47 × 10^{-6}/K are also obtained on request.

NOTE 2 The nominal temperature coefficients and their tolerances are defined using the capacitance change between the temperatures 20 °C and 85 °C.

NOTE 3 A capacitor with a temperature coefficient of 0 × 10^{-6}/K and a tolerance on temperature coefficient of ±30 × 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 case of reference temperature 25 °C, see Table B.1 for an explanation of the permissible relative variation of capacitance.

Figures A.1 to 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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Table 3 – Combination of temperature coefficient and tolerance

Temperature coefficients		Permissible relative variation in capacitance in parts per 1 000 between 20 °C and a given temperature							
		Lower category temperatures				Upper category temperatures			
α 10^{-6}/K	Tol. [a] 10^{-6}/K	–55 °C	–40 °C	–25 °C	–10 °C	+70 °C	+85 °C	+100 °C	+125 °C
+100	±15 (F) ±30 (G)	–8,63/–5,08 –9,75/–3,71	–6,90/–4,06 –7,80/–2,96	–5,18/–3,05 –5,85/–2,22	–3,45/–2,03 –3,90/–1,48	4,25/5,75 3,50/6,50	5,53/7,48 4,55/8,45	6,80/9,20 5,60/10,4	8,93/12,1 7,35/13,7
0	±15 (F) ±30 (G) ±60 (H)	–1,13/4,07 –2,25/5,45 –4,50/8,19	–0,900/3,26 –1,80/4,36 –3,60/6,55	–0,675/2,44 –1,35/3,27 –2,70/4,91	–0,450/1,63 –0,900/2,18 –1,80/3,28	–0,750/0,750 –1,50/1,50 –3,00/3,00	–0,975/0,975 –1,95/1,95 –3,90/3,90	–1,20/1,20 –2,40/2,40 –4,80/4,80	–1,58/1,58 –3,15/3,15 –6,30/6,30
–33	±15 (F) ±30 (G)	1,35/7,09 0,225/8,46	1,08/5.67 0,180/6,77	0,810/4,26 0,135/5,08	0,540/2,84 0,090/3,39	–2,40/–0,900 –3,15/–0,150	–3,12/–1,17 –4,10/–0,195	–3,84/–1,44 –5,04/0,240	–5,04/–1,89 –6,62/–0,315
–75	±15 (F) ±30 (G)	4,50/10,9 3,38/12,3	3,60/8,75 2,70/9,85	2,70/6,56 2,03/7,38	1,80/4,37 1,35/4,92	–4,50/–3,00 –5,25/–2,25	–5,85/–3,90 –6,83/–2,93	–7,20/–4,80 –8,40/–3,60	–9,45/–6,30 –11,0/–4,73
–150	±15 (F) ±30 (G) ±60 (H)	10,1/17,8 9,00/19,2 6,75/21,9	8,10/14,2 7,20/15,3 5,40/17,5	6,08/10.7 5,40/11,5 4,05/13,1	4,05/7,12 3,60/7,67 2,70/8,77	–8,25/–6,75 –9,00/–6,00 –10,5/–4,50	–10,7/–8,78 –11,7/–7,80 –13,7/–5,85	–13,2/–10,8 –14,4/–9,60 –16,8/–7,20	–17,3/–14,2 –18,9/–12,6 –22,1/–9,45
–220	±15 (F) ±30 (G) ±60 (H)	15,4/24,2 14,3/25,6 12,0/28,3	12,3/19,4 11,4/20,5 9,60/22,7	9,23/14,5 8,55/15,3 7,20/17,0	6,15/9,68 5,70/10,2 4,80/11,3	–11.8/–10,3 –12,5/–9,50 –14,0/–8,00	–15,3/–13,3 –16,3/–12,4 –18,2/–10,4	–18,8/–16,4 –20,0/–15,2 –22,4/–12,8	–24,7/–21,5 –26,3/–20,0 –29.4/–16,8
–330	±30 (G) ±60 (H)	22,5/35,6 20,3/38,4	18,0/28,5 16,2/30,7	13,5/21,4 12,2/23,0	9,00/14,3 8,10/15,4	–18,0/–15,0 –19.5/–13,5	–23,4/–19,5 –25,4/–17,6	–28,8/–24,0 –31,2/–21,6	–37,8/–31,5 –41,0/–28,4
–470	±30 (G) ±60 (H)	33,0/48,5 30,8/51,2	26,4/38,8 24,6/41,0	19,8/29,1 18,5/30,7	13,2/19,4 12,3/20,5	–25,0/–22,0 –26,5/–20,5	–32,5/–28,6 –34,5/–26,7	–40,0/–35,2 –42,4/–32,8	–52,5/–46,2 –55,7/–43,1
–750	±60 (H) ±120 (J) ±250 (K)	51,8/76,8 47,3/82,3 37,5/94,2	41,4/61,5 37,8/65,8 30,0/75,4	31,1/46,1 28,4/49,4 22,5/56,5	20,7/30,7 18,9/32,9 15,0/37,7	–40,5/–34,5 –43,5/–31,5 –50,0/–25,0	–52,7/–44,9 –56,6/–41,0 –65,0/–32,5	–64,8/–55,2 –69,6/–50,4 –80,0/–40,0	–85,1/–72,5 –91,4/–66,2 –105/–52,5
–1 000	±60 (H) ±120 (J) ±250 (K)	70,5/99,7 66,0/105 56,3/117	56,4/79,8 52,8/84,1 45,0/93,7	42,3/59,8 39,6/63,1 33,8/70,2	28,2/39,9 26,4/42,1 22,5/46,8	–53,0/–47,0 –56,0/–44,0 –62,5/–37,5	–68,9/–61,1 –72,8/–57,2 –81,3/–48,8	–84,8/–75,2 –89,6/–70,4 –100/–60,0	–111/–98,7 –118/–92,4 –131/–78,8

Temperature coefficients		Permissible relative variation in capacitance in parts per 1 000 between 20 °C and a given temperature							
		Lower category temperatures				Upper category temperatures			
α 10^{-6}/K	Tol. [a] 10^{-6}/K	–55 °C	–40 °C	–25 °C	–10 °C	+70 °C	+85 °C	+100 °C	+125 °C
–1 500	±250 (K)	93,8/163	75,0/130	56,3/97,7	37,5/65,1	–87,5/–62,5	–114/–81,3	–140/–100	–184/–131
–2 200	±500 (L)	128/250	102/200	76,5/150	51,0/99,9	–135/–85,0	–176/–111	–216/–136	–284/–179
–3 300	±500 (L)	210/350	168/280	126/210	84,0/140	–190/–140	–247/–182	–304/–224	–399/–294
–4 700	±1 000 (M)	278/524	222/419	167/315	111/210	–285/–185	–371/–241	–456/–296	–599/–389
–5 600	±1 000 (M)	345/607	276/485	207/364	138/243	–330/–230	–429/–299	–528/–368	–693/–483

NOTE Formulas for calculation of the permissible relative variation in capacitance:

Permissible relative variation in the temperature range from 20°C to the upper category temperature:

$$\Delta C/C\ (10^{-3}) = (\alpha \pm |\delta|) \times (UCT - 20)/1\ 000 \quad (1)$$

Permissible relative variation in the temperature range from 20°C to the lower category temperature:

a) lower permissible relative variation in capacitance from 20°C to lower category temperature:

$$\Delta C/C\ (10^{-3}) = (\alpha \pm |\delta|) \times (LCT - 20)/1\ 000 \quad (2)$$

b) upper permissible relative variation in capacitance from 20°C to lower category temperature:

$$\Delta C/C\ (10^{-3}) = [(-36) - (1{,}22 \times |\delta|) + (0{,}22 \times \alpha) + \alpha] \times (LCT - 20)/1\ 000 \quad (3)$$

α -Temperature coefficient
δ -Tolerance of α
LCT -Lower category temperature
UCT -Upper category temperature

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