



SLOVENSKI STANDARD
oSIST prEN IEC 60384-8:2023

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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

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| 31.060.20 | Keramični kondenzatorji in sljudni kondenzatorji | Ceramic and mica capacitors |

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| IEC TC 40 : CAPACITORS AND RESISTORS FOR ELECTRONIC EQUIPMENT | |
| SECRETARIAT: Netherlands | SECRETARY: Mr Ronald Drenthen |
| OF INTEREST TO THE FOLLOWING COMMITTEES: | PROPOSED HORIZONTAL STANDARD: <input type="checkbox"/> Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary. |
| FUNCTIONS CONCERNED: <input type="checkbox"/> EMC <input type="checkbox"/> ENVIRONMENT <input type="checkbox"/> QUALITY ASSURANCE <input type="checkbox"/> SAFETY | |
| <input checked="" type="checkbox"/> 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. | <input type="checkbox"/> 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

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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:
- 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.
 - The terms have been replaced by the letter symbols in Table 3.
 - 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.
 - Annex B has been changed informative into normative.

210 e) C.5(Test schedule for quality conformance inspection) has been newly added to withdraw the blank
211 detail specification: IEC 60384-8-1.

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

| Draft | Report on voting |
|------------|------------------|
| XX/XX/FDIS | XX/XX/RVD |

213
214 Full information on the voting for its approval can be found in the report on voting indicated in the above
215 table.

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

217 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance
218 with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at
219 https://www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
220 described in greater detail at <https://www.iec.ch/standardsdev/publications>.

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

- 224 • reconfirmed,
- 225 • withdrawn,
- 226 • replaced by a revised edition, or
- 227 • amended.

228
229

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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 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

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

272 3.2

273 subclass

274 for a given nominal temperature coefficient; it is defined by the tolerance on the temperature coefficient
275 (see Table 2)

276 Note 1 to entry: The nominal temperature coefficient value and its tolerance refer to the temperature interval of +20 °C or
277 +25 °C to +85 °C but because in practice TC curves are not strictly linear, it is necessary to define limiting capacitance
278 deviations ($\Delta C/C$) for other temperatures (see Table 3 and Annex B). The same information is expressed in graphical form in
279 Figures A.1 to A.15.

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

282 3.3

283 rated voltage

284 U_R

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

287 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
288 capacitor.

289 4 Preferred ratings and characteristics

290 4.1 Preferred characteristics

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

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

294 For reference temperature of 20 °C or 25 °C, the lower and upper category temperatures and the
295 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

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

297 4.2 Preferred values of ratings

298 4.2.1 Rated temperature

299 For capacitors covered by this standard, the rated temperature is equal to the upper category
300 temperature.

301 4.2.2 Rated voltage (U_R)

302 The preferred values of rated voltage are: 25, 40, 63, 100, 160, 250, 400, 630, 1 000, 1 600, 2 500,
303 4 000 and 6 300 V. These values conform to the basic series of preferred values R5 given in ISO 3. If
304 other values are needed they shall be chosen from the R10 series.

305 The sum of the DC voltage and the peak AC voltage applied to the capacitor shall not exceed the rated
306 voltage.

307 4.2.3 Category voltage (U_C)

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

310 **4.2.4 Preferred values of nominal capacitance and associated tolerance values**311 **4.2.4.1 Preferred values of nominal capacitance**

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

313 **4.2.4.2 Preferred tolerances on nominal capacitance**

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

315 **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 |

316

317 **4.2.5 Temperature coefficient (α)**318 **4.2.5.1 Nominal temperature coefficient and tolerance**

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

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

326 For values of capacitance lower than these minimum values:

- 327 a) The detail specification shall specify a multiplying factor for the tolerance on α , as well as the
 328 permissible changes of capacitance at the lower and upper category temperature;
- 329 b) Special methods of measurement may be necessary and, if required, shall be stated in the detail
 330 specification.
- 331 c) Permissible relative variation of capacitance

332 **Table 2 – Nominal temperature coefficient and tolerances (reference temperature 20 °C)**

| Nominal temperature coefficient (α) $10^{-6}/\text{K}$ | Tolerance on temperature coefficient $10^{-6}/\text{K}$ | Subclass | Letter code | | Colour code for temperature coefficient |
|--|--|----------|-------------|-----------|---|
| | | | α | Tolerance | |
| +100 | ± 15 | 1A | A | F | Red + Violet |
| | ± 30 | 1B | | G | |
| 0 | ± 15 | 1A | C | F | Black |
| | ± 30 | 1B | | G | |
| | ± 60 | 1F | | H | |
| -33 | ± 15 | 1A | H | F | Brown |
| | ± 30 | 1B | | G | |
| -75 | ± 15 | 1A | L | F | Red |
| | ± 30 | 1B | | G | |

| | | | | | |
|-------------------|---------------------|----------------|----|-------------|-----------------|
| -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 $+33 \times 10^{-6}/K$ and $-47 \times 10^{-6}/K$ 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 $0 \times 10^{-6}/K$ 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.

333 4.2.5.2 Permissible relative variation of capacitance

334 Table 3 shows for each combination of temperature coefficient and tolerance the permissible relative
 335 variation of capacitance expressed in parts per thousand at both the upper and lower category
 336 temperatures. Temperature coefficients and tolerances are expressed in parts per million per Kelvin
 337 ($10^{-6}/K$). In case of reference temperature 25 °C, see Table B.1 for an explanation of the permissible
 338 relative variation of capacitance.

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

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) | -8,63/-5,08 | -6,90/-4,06 | -5,18/-3,05 | -3,45/-2,03 | 4,25/5,75 | 5,53/7,48 | 6,80/9,20 | 8,93/12,1 |
| | ±30 (G) | -9,75/-3,71 | -7,80/-2,96 | -5,85/-2,22 | -3,90/-1,48 | 3,50/6,50 | 4,55/8,45 | 5,60/10,4 | 7,35/13,7 |
| 0 | ±15 (F) | -1,13/4,07 | -0,900/3,26 | -0,675/2,44 | -0,450/1,63 | -0,750/0,750 | -0,975/0,975 | -1,20/1,20 | -1,58/1,58 |
| | ±30 (G) | -2,25/5,45 | -1,80/4,36 | -1,35/3,27 | -0,900/2,18 | -1,50/1,50 | -1,95/1,95 | -2,40/2,40 | -3,15/3,15 |
| | ±60 (H) | -4,50/8,19 | -3,60/6,55 | -2,70/4,91 | -1,80/3,28 | -3,00/3,00 | -3,90/3,90 | -4,80/4,80 | -6,30/6,30 |
| -33 | ±15 (F) | 1,35/7,09 | 1,08/5,67 | 0,810/4,26 | 0,540/2,84 | -2,40/-0,900 | -3,12/-1,17 | -3,84/-1,44 | -5,04/-1,89 |
| | ±30 (G) | 0,225/8,46 | 0,180/6,77 | 0,135/5,08 | 0,090/3,39 | -3,15/-0,150 | -4,10/-0,195 | -5,04/0,240 | -6,62/-0,315 |
| -75 | ±15 (F) | 4,50/10,9 | 3,60/8,75 | 2,70/6,56 | 1,80/4,37 | -4,50/-3,00 | -5,85/-3,90 | -7,20/-4,80 | -9,45/-6,30 |
| | ±30 (G) | 3,38/12,3 | 2,70/9,85 | 2,03/7,38 | 1,35/4,92 | -5,25/-2,25 | -6,83/-2,93 | -8,40/-3,60 | -11,0/-4,73 |
| -150 | ±15 (F) | 10,1/17,8 | 8,10/14,2 | 6,08/10,7 | 4,05/7,12 | -8,25/-6,75 | -10,7/-8,78 | -13,2/-10,8 | -17,3/-14,2 |
| | ±30 (G) | 9,00/19,2 | 7,20/15,3 | 5,40/11,5 | 3,60/7,67 | -9,00/-6,00 | -11,7/-7,80 | -14,4/-9,60 | -18,9/-12,6 |
| | ±60 (H) | 6,75/21,9 | 5,40/17,5 | 4,05/13,1 | 2,70/8,77 | -10,5/-4,50 | -13,7/-5,85 | -16,8/-7,20 | -22,1/-9,45 |
| -220 | ±15 (F) | 15,4/24,2 | 12,3/19,4 | 9,23/14,5 | 6,15/9,68 | -11,8/-10,3 | -15,3/-13,3 | -18,8/-16,4 | -24,7/-21,5 |
| | ±30 (G) | 14,3/25,6 | 11,4/20,5 | 8,55/15,3 | 5,70/10,2 | -12,5/-9,50 | -16,3/-12,4 | -20,0/-15,2 | -26,3/-20,0 |
| | ±60 (H) | 12,0/28,3 | 9,60/22,7 | 7,20/17,0 | 4,80/11,3 | -14,0/-8,00 | -18,2/-10,4 | -22,4/-12,8 | -29,4/-16,8 |
| -330 | ±30 (G) | 22,5/35,6 | 18,0/28,5 | 13,5/21,4 | 9,00/14,3 | -18,0/-15,0 | -23,4/-19,5 | -28,8/-24,0 | -37,8/-31,5 |
| | ±60 (H) | 20,3/38,4 | 16,2/30,7 | 12,2/23,0 | 8,10/15,4 | -19,5/-13,5 | -25,4/-17,6 | -31,2/-21,6 | -41,0/-28,4 |
| -470 | ±30 (G) | 33,0/48,5 | 26,4/38,8 | 19,8/29,1 | 13,2/19,4 | -25,0/-22,0 | -32,5/-28,6 | -40,0/-35,2 | -52,5/-46,2 |
| | ±60 (H) | 30,8/51,2 | 24,6/41,0 | 18,5/30,7 | 12,3/20,5 | -26,5/-20,5 | -34,5/-26,7 | -42,4/-32,8 | -55,7/-43,1 |
| -750 | ±60 (H) | 51,8/76,8 | 41,4/61,5 | 31,1/46,1 | 20,7/30,7 | -40,5/-34,5 | -52,7/-44,9 | -64,8/-55,2 | -85,1/-72,5 |
| | ±120 (J) | 47,3/82,3 | 37,8/65,8 | 28,4/49,4 | 18,9/32,9 | -43,5/-31,5 | -56,6/-41,0 | -69,6/-50,4 | -91,4/-66,2 |
| | ±250 (K) | 37,5/94,2 | 30,0/75,4 | 22,5/56,5 | 15,0/37,7 | -50,0/-25,0 | -65,0/-32,5 | -80,0/-40,0 | -105/-52,5 |
| -1 000 | ±60 (H) | 70,5/99,7 | 56,4/79,8 | 42,3/59,8 | 28,2/39,9 | -53,0/-47,0 | -68,9/-61,1 | -84,8/-75,2 | -111/-98,7 |
| | ±120 (J) | 66,0/105 | 52,8/84,1 | 39,6/63,1 | 26,4/42,1 | -56,0/-44,0 | -72,8/-57,2 | -89,6/-70,4 | -118/-92,4 |
| | ±250 (K) | 56,3/117 | 45,0/93,7 | 33,8/70,2 | 22,5/46,8 | -62,5/-37,5 | -81,3/-48,8 | -100/-60,0 | -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