
Pritrjeni kondenzatorji za uporabo v elektronski opremi - 9. del: Področna specifikacija: pritrjeni kondenzatorji s keramičnim dielektrikom, razred 2

Fixed capacitors for use in electronic equipment - Part 9: Sectional specification: Fixed capacitors of ceramic dielectric, Class 2

Festkondensatoren zur Verwendung in Geräten der Elektronik - Teil 9: Rahmenspezifikation – Keramik-Festkondensatoren, Klasse 2

Condensateurs fixes utilisés dans les équipements électroniques - Partie 9: Spécification intermédiaire: Condensateurs fixes à diélectrique en céramique, Classe 2

Ta slovenski standard je istoveten z: prEN IEC 60384-9:2023

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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 9: Sectional specification: Fixed capacitors of ceramic dielectric, Class 2

PROPOSED STABILITY DATE: 2032

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –**Part 9: Sectional specification:
Fixed capacitors of ceramic dielectric, Class 2**

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IEC 60384-9 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 fourth 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 requirements of reference temperature 25°C has been added in Table 7, Table 9, Table 11, Table 13 and Table 15
- c) The table of temperature characteristics of capacitance for the reference temperature 25°C have been added in Table B.1, Table B.2 and Table B.3.

- 208 d) Annex B has been changed informative into normative.
- 209 e) C.5(Test schedule for quality conformance inspection) has been newly added to withdraw the blank
- 210 detail specification: IEC 60384-9-1.

211

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.

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FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 9: Sectional specification: Fixed capacitors of ceramic dielectric, Class 2

1 Scope

This part of IEC 60384 is applicable to fixed capacitors of ceramic dielectric with a defined temperature coefficient (dielectric Class 2), intended for use in electronic equipment, including leadless capacitors but excluding fixed surface mount multilayer capacitors of ceramic dielectric, which are covered by IEC 60384-22 (Class 2).

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 2

capacitor which 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 the non-linear change of capacitance over the category temperature range (see Table 2).

- 272 **3.2**
 273 **subclass**
 274 maximum percentage change of capacitance within the category temperature range with respect to the
 275 capacitance at the reference temperature 20 °C or 25 °C
- 276 Note 1 to entry: The subclass may be expressed in code form (see Table 2 and Annex B).
- 277 **3.3**
 278 **rated voltage**
 279 U_R
 280 maximum-DC voltage that can be applied continuously to the terminations of a capacitor at the rated
 281 temperature
- 282 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
 283 capacitor.
- 284 **4 Preferred ratings and characteristics**
- 285 **4.1 Preferred characteristics**
 286 Preferred climatic categories only shall be given in the preferred characteristics.
- 287 The capacitors covered by this standard are classified into climatic categories in accordance with the
 288 general rules given in IEC 60068-1:2013, Annex A.
- 289 For reference temperature of 20 °C, the lower and upper category temperatures and the duration of the
 290 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, +125 °C and +150 °C
 - duration of the damp heat, steady state test (40 °C, 93 % RH): 4, 10, 21 and 56 days
- 291 For reference temperature of 25 °C, the lower and upper category temperatures shall be chosen from
 292 Table B.1 in Annex B.
- 293 The severities for the cold and dry heat tests are the lower and upper category temperatures respectively.
- 294 **4.2 Preferred values of ratings**
- 295 **4.2.1 Rated temperature**
 296 For capacitors covered by this standard, the rated temperature is equal to the upper category
 297 temperature.
- 298 **4.2.2 Rated voltage (U_R)**
 299 The preferred values of rated voltage are: 25, 40, 63, 100, 160, 250, 400, 630, 1 000, 1 600, 2 500,
 300 4 000 and 6 300 V. These values conform to the basic series of preferred values R5 given in ISO 3. If
 301 other values are needed they shall be chosen from the R10 series. The sum of the DC voltage and the
 302 peak AC voltage or the peak to peak AC voltage, whichever is the greater, applied to the capacitor shall
 303 not exceed the rated voltage.
- 304 **4.2.3 Category voltage (U_C)**
 305 Since the rated temperature is defined as the upper category temperature, the category voltage is equal
 306 to the rated voltage, as defined in IEC 60384-1:2021, 3.5.

307 **4.2.4 Preferred values of nominal capacitance and associated tolerance values**308 **4.2.4.1 Preferred values of nominal capacitance**

309 Nominal capacitance values should be taken from the E3, E6 and E12 series given in IEC 60063.

310 **4.2.4.2 Preferred tolerances on nominal capacitance**

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

312 **Table 1 – Preferred tolerance on nominal capacitance**

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

313

314 **4.2.5 Temperature characteristic of capacitance**

315 Table 2 shows the temperature characteristic with and without DC voltage applied for the reference
 316 temperature 20 °C. The method of coding the subclass is also given; for example a dielectric with a
 317 percentage change of ±20 % without DC voltage applied over the temperature range from –55 °C to
 318 +125 °C, will be defined as a dielectric of Class 2C1. The temperature characteristics, category
 319 temperatures and corresponding codes for the reference temperature 25 °C are given in Annex B.

320 The temperature range, for which the temperature characteristics of the dielectric is defined, is the same
 321 as the category temperature range.

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Table 2 – Temperature characteristic of capacitance

Sub-class letter code	Maximum capacitance change within the category temperature range with respect to the capacitance at 20 °C measured with and without a DC voltage applied %		Category temperature range and corresponding number code					
			-55/+150 °C	-55/+125 °C	-55/+85 °C	-40/+85 °C	-25/+85 °C	+10/+85 °C
	without DC voltage applied	with DC voltage applied (NOTE 1)	0	1	2	3	4	6
2B	±10	Requirements specified in the detail specification						
2C	±20							
2D	+20/-30							
2E	+22/-56							
2F	+30/-80							
2R	±15							
When the upper category temperature is above 125 °C, the limits of capacitance change, both with and without DC voltage applied, should be given in the detail specification.								
NOTE 1 DC voltage applied is either rated voltage or the voltage specified in the detail specification.								

323

324

325 NOTE See Annex B for preferred values of the temperature characteristics for the reference
326 temperature 25 °C.

327 **5 Test and measurement procedures**

328 **5.1 General**

329 This clause supplements the information given in IEC 60384-1:2021, Clause 5 to Clause 10.

330 **5.2 Special preconditioning**

331 Unless otherwise specified in the detail specification, the special preconditioning, when specified in
332 this document before a test or a sequence of tests, shall be made under the following conditions:
333 exposure at upper category temperature or at such higher temperature as may be specified in the
334 detail specification during 1 h, followed by recovery during 24 h ± 1 h at standard atmospheric
335 conditions for testing.

336 NOTE Class 2 capacitors lose capacitance continuously with time following a logarithmic law (this is called ageing). However
337 if the capacitor is heated to a temperature above the Curie point of its dielectric then "de-ageing" takes place, i.e. the
338 capacitance lost through "ageing" is regained, and "ageing" recommences from the time when the capacitor recools.

339 The purpose of special preconditioning is to bring the capacitor to a defined stage regardless of its previous history (see Clause
340 A.4 for further information).

341 **5.3 Visual examination and check of dimensions**

342 See IEC 60384-1:2021, 7.1.

343 **5.4 Electrical tests**

344 **5.4.1 Capacitance**

345 **5.4.1.1 General**

346 See IEC 60384-1:2021, 6.3, with the details of 5.4.1.2 and 5.4.1.3.

347 **5.4.1.2 Measuring conditions**

348 The capacitance shall be measured in accordance with Table 3 and the following details:

349

Table 3 – Measuring conditions

Reference temperature	Subclass	Measuring voltage	Referee voltage ^a
20 °C	2B, 2C, 2X	1,0 ± 0,2 V	1,0 ± 0,02 V
	2D, 2E, 2F, 2R	0,3 ± 0,2 V or as specified in the detail specification	0,3 ± 0,02 V or as specified in the detail specification
25 °C	R,S,T,U	1,0 ± 0,2 V	1,0 ± 0,02 V

^a In case of dispute about results of measurements, referee voltage is applied.

350

351 Frequency: $C_N < 100 \text{ pF}$ $f = 1 \text{ MHz}$ unless otherwise specified in the detail specification

352 $C_N \geq 100 \text{ pF}$ $f = 1 \text{ kHz} \pm 20 \%$ for measuring purposes and 1 kHz for referee tests.

353 $C_N > 10 \mu\text{F}$ $f = 100\text{Hz}$ or $120\text{Hz} \pm 20 \%$ with measuring voltage $0.5\text{V} \pm 0.2\text{V}$ for
354 measuring purposes and 100Hz or 120Hz for referee tests.
355

356 5.4.1.3 Requirements

357 The capacitance value shall correspond with the rated value taking into account the specified tolerance.

358 For referee measurements the capacitance value shall be the value extrapolated to an ageing time of 1
359 000 h, unless otherwise specified in the detail specification (for explanation see Annex A).

360 If applying the ageing time other than 1 000 h, that may be specified in the detail specification.

361 5.4.2 Tangent of loss angle ($\tan \delta$)

362 5.4.2.1 General

363 See IEC 60384-1:2021, 6.4, with the details of 5.4.2.2 to 5.4.2.4.

364 5.4.2.2 Measuring conditions

365 See 7.1.1.

366 5.4.2.3 Accuracy

367 The accuracy of the measuring instruments shall be such that the measuring error does not exceed
368 0,001.

369 5.4.2.4 Requirements

370 The tangent of loss angle shall not exceed 0,035; or such lower value as may be given in the detail
371 specification.

372 5.4.3 Insulation resistance (R_i)

373 5.4.3.1 General

374 See IEC 60384-1:2021, 6.1, with the details of 5.4.3.2 and 5.4.3.3.

375 5.4.3.2 Measuring conditions

376 See IEC 60384-1:2021, 6.1.2, with the following details:

377 For $U_R < 100 \text{ V}$, the measuring voltage may be of any value not greater than U_R , the reference voltage
378 being U_R .

379 The voltage shall be applied immediately at the specified value for 1 min ± 5 s for qualification approval
380 testing and periodic tests (Group C). For lot-by-lot testing (Group A), the test may be terminated in a
381 shorter time, if the required value of insulation resistance is reached.

382 The product of the internal resistance of the voltage source and the nominal capacitance of the capacitor
383 shall not exceed 1 s unless otherwise specified in the detail specification.

384 The charge current shall not exceed 0,05 A.

385 The insulation resistance (R_i) shall be measured at the end of the 1 min period.

386 5.4.3.3 Requirements

387 The insulation resistance (R_i) shall meet the requirements given in Table 4.

388 **Table 4 – Insulation resistance requirements**

Style	Measuring points	$C_N \leq 25$ nF	$C_N > 25$ nF
		R_i	$R_i \times C_N$
Insulated	1a and 1c	$\geq 4\,000$ M Ω	≥ 100 s
Non-insulated	1a		

389

390 5.4.4 Voltage proof

391 5.4.4.1 General

392 See IEC 60384-1:2021, 6.2, with the details of 5.4.4.2 to 5.4.4.4.

393 5.4.4.2 Test conditions

394 The product of R_i and the nominal capacitance C_x shall be smaller than or equal to 1 s.

395 The charge current shall not exceed 0,05 A.

396 5.4.4.3 Test voltage

397 The voltages in Table 5 shall be applied between the measuring points of Table 3 in IEC 60384-1:2021
398 for a period of 1 min for qualification approval testing and for a period of 1 s for the lot-by-lot quality
399 conformance testing.

400

Table 5 – Test voltages

Type	Rated voltage V	Test voltage V
Leaded multilayer ceramic capacitors	$U_R \leq 100$	$2,5 U_R$
	$100 < U_R \leq 200$	$1,5 U_R + 100$
	$200 < U_R \leq 500$	$1,3 U_R + 100$
	$500 < U_R$	$1,3 U_R$
Others	$U_R \leq 500$	$2,5 U_R$
	$U_R > 500$	$1,5 U_R + 500$
NOTE If $U_R > 500$ V, then the test voltage for Test C (external insulation) is $U_R + 500$ V or as specified in the detail specification.		1,5

401

402 5.4.4.4 Requirement

403 There shall be no breakdown or flashover during the test.