
Sectional specification: Fixed multilayer ceramic surface mounting capacitors - Assessment levels EZ and DZ

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Rahmenspezifikation: Oberflächenmontierbare Vielschichtkeramik-Festkondensatoren - Qualitätsbewertungsstufen EZ und DZ

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English version

**Sectional Specification:
Fixed multilayer ceramic surface mounting capacitors
Assessment levels EZ and DZ**

Rahmenspezifikation:
Oberflächenmontierbare
Vielschichtkeramik-Festkondensatoren
Qualitätsbewertungsstufen EZ und DZ

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

This European Standard was prepared by CENELEC/TC CECC/SC 40XA, Capacitors.

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1 - GENERAL

1.1 Scope

This specification applies to fixed unencapsulated multilayer surface mounting capacitors of ceramic dielectric Class 1 and Class 2 with rated voltage normally not exceeding 200 V. These capacitors generally have terminations consisting of metallized connecting pads or solderable strips and are intended to be mounted directly onto substrates for hybrid circuits or onto printed boards.

The object of this specification is to prescribe preferred ratings and characteristics and to select from the general specification EN 130000 the appropriate quality assessment procedures, tests and measuring methods and to give general performance requirements for this type of capacitor.

1.2 Related documents

ISO 3	Preferred numbers - Series of preferred numbers
IEC 62	Marking codes for resistors and capacitors
IEC 63 Amendment 1 (1967) Amendment 2 (1977)	Preferred number series for resistors and capacitors
IEC 68	Basic environmental testing procedures
IEC 384-10	Sectional specification: Fixed multilayer ceramic chip capacitors
IEC 410	Sampling plans and procedures for inspection by attributes
EN 130000	Generic specification: Fixed capacitors

Note - The above references apply to the current editions, except for IEC 68 for which the edition referenced in the generic specification.

1.3 Information to be given in a detail specification

Detail specifications shall be derived from the relevant blank detail specification.

Detail specifications shall not specify requirements inferior to those of the generic, sectional or blank detail specification. When more severe requirements are included, they shall be listed in 1.9 of the detail specification and indicated in the test schedules, for example by an asterisk.

The following information shall be given in each detail specification and the values quoted shall preferably be selected from those given in the appropriate clause of this sectional specification.

1.3.1 Dimensions and outline drawing

The detail specification shall give an illustration of the capacitor as an aid to easy recognition and for comparison of the capacitor with others. Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be given. All dimensions shall be stated in mm.

NOTE - The information given in 1.3.1 may for convenience, be presented in tabular form.

Normally the numerical values shall be given for the length, the width and height of the body. When necessary, for example when a number of case sizes are covered by a detail specification, the dimensions and their associated tolerances shall be placed in a table below the drawing.

When the configuration is other than as described above, the detail specification shall state such dimensional information as will adequately describe the capacitor.

1.3.2 Mounting

The detail specification shall specify the method of mounting to be applied for normal use. Mounting for test and measurement purposes (when required) shall be in accordance with 4.4.

1.3.3 Ratings and characteristics

The ratings and characteristics shall be in accordance with the relevant clauses of this specification, together with the following:

1.3.3.1 Rated capacitance range

See 2.2.4.

NOTE - When products approved to the detail specification have different ranges, the following statement should be added: "The range of capacitance values available in each voltage range is given in CECC 00 200 (Register of Firms, Products and Services Approved under the CECC System)". [SIST EN 132100:2002](https://standards.iteh.ai/catalog/standards/sist/57bf6465-f095-41f0-a8b7-8c0521c05ec/sist-en-132100-2002)

1.3.3.2 Particular characteristics

Additional characteristics may be listed, when they are considered necessary to specify adequately the component for design and application purposes.

1.3.4 Marking

The detail specification shall specify the content of the marking on the capacitor and on the package. Deviations from 1.5 of this specification shall be specifically stated.

1.4 Terminology

In addition to the applicable terms and definitions of EN 130000 the following definitions apply:

1.4.1 Surface mounting capacitor

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

1.4.2 Fixed capacitor of ceramic dielectric Class 1

1.4.2.1 A 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.

The ceramic dielectric is defined by its rated temperature coefficient (α).

1.4.2.2 For a given rated temperature coefficient the sub-class is defined by the rated tolerance on the temperature coefficient. The sub-class may be expressed in coded form (see Table 3 in 2.2.5).

NOTE - The rated temperature coefficient value and its tolerance refer to the temperature interval of 20 °C to 85 °C but because in practice temperature coefficient curves are not strictly linear, it is necessary to define limiting capacitance deviations ($\Delta C/C$) for other temperatures (see Table 4 in 2.2.5).

1.4.3 Fixed capacitor of ceramic dielectric Class 2

1.4.3.1 A 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. The ceramic dielectric is characterized by a non-linear change of capacitance over the category temperature range (see Table 5 in 2.2.6).

1.4.3.2 The sub-class is defined by the maximum percentage change of capacitance within the category temperature range with respect to the capacitance at 20 °C.

The sub-class may be expressed in coded form (see Table 5 in 2.2.6).

1.4.4 Rated voltage (U_R)

The maximum d.c. voltage which may be applied continuously to the terminations of a capacitor at the rated temperature.

NOTE - The sum of the d.c. voltage and the peak alternating voltage applied to the capacitor shall not exceed the rated voltage. The value of the a.c. voltage shall not exceed the value determined by the permissible reactive power.

1.5 Marking

See 2.4 of EN 130000 with the following details:

1.5.1 The information given in the marking is normally selected from the following list; the relative importance of each item is indicated by its position in the list:

- (1) Rated capacitance
- (2) Rated voltage (d.c. voltage may be indicated by the symbol — or =)
- (3) Tolerance on rated capacitance
- (4) Temperature coefficient and its tolerance (Class 1) or dielectric sub-class (Class 2), as applicable (according to 2.2.5 and 2.2.6)
- (5) Year and month (or week) of manufacture
- (6) Manufacturer's name or trade mark
- (7) Climatic category
- (8) Manufacturer's type designation
- (9) Reference to the detail specification.

1.5.2 Surface mounting capacitors are generally not marked on the body. If marking is required it shall be described in the detail specification by using items selected from 1.5.1.

1.5.3 The package containing the capacitor(s) shall be marked with all the information listed in 1.5.1.

1.5.4 Any additional marking shall be so applied that no confusion can arise.

2 - PREFERRED RATINGS AND CHARACTERISTICS

2.1 Preferred climatic categories

The capacitors covered by this specification are classified into climatic categories according to the general rules given in IEC 68-1.

The lower and upper category temperature 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 and +125 °C

Duration of the damp heat, steady state test: 4, 10, 21 and 56 days

The severities for 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 surface mounting capacitor in its unmounted state. The climatic performance of the surface mounting capacitor after mounting is greatly influenced by the mounting substrate, the mounting method (see 4.4) and the final coating.

2.2 Preferred values of ratings

2.2.1 Rated temperature

The rated temperature is equal to the upper category temperature, unless the upper category temperature exceeds 125 °C.

2.2.2 Rated voltage (U_R)

Preferred values of rated voltage are the values of the R5 series of ISO 3. If other values are required they shall preferably be chosen from the R10 series.

2.2.3 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 2.2.17 of EN 130000.

2.2.4 Rated capacitance and associated tolerance values

(1) Rated capacitance (C_R)

Rated capacitance values shall be taken from the series of the IEC 63; the E3, E6, E12 and E24 series are preferred.

(2) Preferred tolerances on rated capacitance for Class 1 capacitors

TABLE 1

Preferred series	Tolerances			
	$C_R \geq 10$ pF	Letter code	$C_R < 10$ pF	Letter code
E6	$\pm 20\%$	M	± 2 pF	G
E12	$\pm 10\%$	K	± 1 pF	F
E24	$\pm 5\%$	J	$\pm 0,5$ pF	D
	$\pm 2\%$	G	$\pm 0,25$ pF	C
	$\pm 1\%$	F	$\pm 0,1$ pF	B

(3) Preferred tolerances on rated capacitance for Class 2 capacitors

TABLE 2

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

2.2.5 Temperature coefficient (α) for Class 1 capacitors

2.2.5.1 Table 3 shows the preferred rated temperature coefficients and the associated tolerances, expressed in parts per million per degree Celsius ($10^{-6}/^{\circ}\text{C}$), and the corresponding sub-classes and codes.

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 this minimum value:

- (1) The tolerance on the temperature coefficient shall be specified in the detail specification, as well as the permissible changes of capacitance at the lower and upper category temperature.
- (2) Special methods of measurement may be necessary and if required shall be stated in the detail specification.

TABLE 3

Rated temperature coefficient α ($10^{-6}/^{\circ}\text{C}$)	Tolerance on temperature coefficient ($10^{-6}/^{\circ}\text{C}$)	Sub-class	Letter code for α	
				Tolerance
+ 100	± 30	1B	A	G
<u>0</u>	± 30	1B	C	G
- 33	± 30	1B	H	G
- 75	± 30	1B	L	G
<u>- 150</u>	± 30	1B	P	G
- 220	± 30	1B	R	G
- 330	± 60	1B	S	H
- 470	± 60	1B	T	H
<u>- 750</u>	± 120	1B	U	J
- 1 000	± 250	1F	Q	K
- 1 500	± 250	1F	V	K
+ 140 $\geq \alpha \geq$ 1 000		1C	SL	-
+ 250 $\geq \alpha \geq$ -1 750		1D	UM	-

NOTE 1 - Preferred temperature coefficients (α) are underlined
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NOTE 2 - The rated 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 zero and a tolerance on temperature coefficient of $\pm 30 \cdot 10^{-6}/^{\circ}\text{C}$ is designated as a CG capacitor (Sub-class 1B)

TABLE 4

Temperature coefficient		Permissible relative variation in capacitance in parts per 1 000 between 20 °C and given temperature									
α $10^{-6}/^{\circ}\text{C}$	Tolerance $10^{-6}/^{\circ}\text{C}$	Lower category temperature					Upper category temperature				
		-55 °C	-40 °C	-25 °C	-10 °C	+70 °C	+85 °C	+100 °C	+125 °C		
+ 100	± 30 (G)	-9,75/4,10	-7,80/-3,38	-5,85/-2,61	-3,90/-1,79	3,42/6,50	4,55/8,45	5,60/10,4	7,35/13,50		
0	± 30 (G)	-2,25/4,05	-1,80/3,09	-1,35/2,20	-0,90/0,139	-1,63/1,50	-1,95/1,95	-2,40/2,42	-3,15/3,23		
- 33	± 30 (G)	0,225/7,05	0,180/5,44	0,135/3,93	0,090/2,52	-3,32/-0,150	-4,10/-0,195	-5,04/-0,233	-6,62/-0,29		
- 75	± 30 (G)	3,38/11,5	2,70/8,89	2,03/6,43	1,35/4,13	-5,51/-2,25	-6,83/-2,93	-8,40/-3,47	-11,0/-4,25		
- 150	± 30 (G)	9,00/18,2	7,20/14,1	5,40/10,3	3,60/6,66	-9,33/-6,00	-11,7/-7,80	-14,4/-9,29	-18,9/-11,5		
- 220	± 30 (G)	14,3/24,5	11,4/19,1	8,58/14,0	5,72/9,07	-12,9/-9,54	-16,2/-12,4	-20,0/-14,9	-26,3/-18,9		
- 330	± 60 (H)	20,3/38,3	16,2/29,9	12,2/21,8	8,12/14,2	-20,2/-13,5	-25,4/-17,6	-31,2/-21,2	-41,4/-26,7		
- 470	± 60 (H)	30,8/51,2	24,6/40,0	18,5/29,3	12,3/19,0	-27,4/-20,5	-34,5/-26,7	-42,4/-32,1	-55,7/-40,5		
- 750	± 120 (J)	47,3/82,4	37,8/64,5	28,4/47,3	18,9/30,8	-45,0/-31,5	-56,6/-41,0	-69,6/-50,3	-91,4/-65,6		
-1 000	± 250 (K)	56,3/117	45,0/91,7	33,8/67,2	22,5/43,8	-64,2/-37,5	-81,3/-48,8	-100/-60,0	-131/-78,8		
-1 500	± 250 (K)	93,8/161	75,0/126	56,3/92,8	37,5/60,6	-89,8/-62,5	-114/-81,3	-140/-100	-184/-131		

NOTE - Preferred temperature coefficient values (α) are underlined.

2.2.5.2 Table 4 shows for each combination of temperature coefficient and tolerance the permissible relative variation of capacitance expressed in parts per thousand at each of the upper and lower category temperatures. Temperature coefficients and tolerances are expressed in parts per million per degree Celsius ($10^{-6}/^{\circ}\text{C}$).

2.2.6 Temperature characteristic of capacitance for Class 2 capacitors

Table 5 denotes with a cross (x) preferred values of temperature characteristic of capacitance with and without d.c. voltage applied. The method of coding the sub-class is also given; for example a dielectric with a percentage change of $\pm 20\%$ without d.c. voltage applied over the temperature range from -55°C to $+125^{\circ}\text{C}$ will be defined as a dielectric of sub-class 2C1.

TABLE 5

Sub-class letter code	Max. capacitance change in % within the category temperature range with respect to the capacitance at 20°C measured with and without a d.c. voltage applied		Category temperature range and corresponding number code				
			$-55/+125^{\circ}\text{C}$	$-55/+85^{\circ}\text{C}$	$-40/+85^{\circ}\text{C}$	$-25/+85^{\circ}\text{C}$	$+10/+85^{\circ}\text{C}$
			without d.c. voltage applied	with rated d.c. voltage applied	1	2	3
2B	± 10	+10/-15	-	x	x	x	-
2C	± 20	+20/-30	x	x	x	-	-
2D	+20/-30	+20/-40	-	-	-	x	-
2E	+22/-56	+22/-70	-	x	x	x	x
2F	+30/-80	+30/-90	-	x	x	x	x
2R	± 15	+15/-40 ¹⁾	x	-	-	-	-
2X	± 15	+15/-25	x	-	-	-	-

1) If required in the detail specification

The temperature range for which the temperature characteristic of the dielectric is defined is the same as the category temperature range.

3 - QUALITY ASSESSMENT PROCEDURES

3.1 Primary stage of manufacture

The primary stage of manufacture is the first common firing of the dielectric-electrode assembly.

3.2 Structurally similar components

Capacitors considered as being structurally similar are capacitors produced with similar processes and materials, though they may be of different case sizes and capacitance and voltage values.

3.3 Certified test records of released lots

The information required in 3.9 of EN 130000 shall be made available when prescribed in the detail specification and when requested by a purchaser. After the endurance test the parameters for which variables information is required are the capacitance, tangent of loss angle and the insulation resistance.

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3.4 Qualification approval (standards.iteh.ai)

The procedures for qualification approval testing are given in 3.5 of the generic specification EN 130000.

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The schedule to be used for qualification approval testing on the basis of lot-by-lot and periodic tests is given in 3.5 of this specification. The procedure using a fixed sample size schedule is given in 3.4.1 and 3.4.2 below.

3.4.1 Sampling

The fixed sample size procedure is described in 3.5.3(2) of EN 130000. The sample shall be representative of the range of capacitors for which approval is sought. This may or may not be the complete range covered by the detail specification.

For each temperature coefficient of Class 1 capacitors and for each temperature characteristic of Class 2 capacitors the sample shall consist of specimens of capacitors of maximum and minimum size and for each of these sizes the maximum capacitance value for the highest rated voltage and the minimum rated voltage of the voltage ranges for which approval is sought. When there are more than four rated voltages an intermediate voltage shall also be tested. Thus for the approval of a range, testing is required of either four or six values (capacitance/voltage combinations) for each temperature coefficient of Class 1 capacitors and for each temperature characteristic of Class 2 capacitors. When the total range consists of less than four values, the number of specimens to be tested shall be that required for four values. When approval is sought for more than one temperature coefficient, see 3.4.2.

Spare specimens are permitted as follows:

One per value which may be used as replacements for specimens which are non-conforming item because of incidents not attributable to the manufacturer.