

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

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

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CONTENTS

FOREWORD.....	5
1 General.....	7
1.1 Scope.....	7
1.2 Object.....	7
1.3 Normative references.....	7
1.4 Information to be given in a detail specification.....	7
1.4.1 General.....	7
1.4.2 Outline drawing and dimensions.....	8
1.4.3 Mounting.....	8
1.4.4 Ratings and characteristics.....	8
1.4.5 Marking.....	9
1.5 Terms and definitions.....	9
1.6 Marking.....	9
1.6.1 General.....	9
1.6.2 Marking on the body.....	10
1.6.3 Marking of the packaging.....	10
1.6.4 Additional marking.....	10
2 Preferred ratings and characteristics.....	10
2.1 Preferred characteristics.....	10
2.2 Preferred values of ratings.....	10
2.2.1 Rated temperature.....	10
2.2.2 Rated voltage (U_R).....	10
2.2.3 Category voltage (U_C).....	11
2.2.4 Preferred values of nominal capacitance and associated tolerance values.....	11
2.2.5 Temperature characteristic of capacitance.....	11
3 Quality assessment procedures.....	12
3.1 Primary stage of manufacture.....	12
3.2 Structurally similar components.....	12
3.3 Certified test records of released lots.....	12
3.4 Qualification approval.....	12
3.4.1 General.....	12
3.4.2 Qualification approval on the basis of the fixed sample size procedure.....	12
3.4.3 Tests.....	13
3.5 Quality conformance inspection.....	18
3.5.1 Formation of inspection lots.....	18
3.5.2 Test schedule.....	19
3.5.3 Delayed delivery.....	19
3.5.4 Assessment levels.....	19
4 Test and measurement procedures.....	20
4.1 General.....	20
4.2 Special preconditioning.....	20
4.3 Visual examination and check of dimensions.....	20
4.4 Electrical tests.....	20
4.4.1 Capacitance.....	20
4.4.2 Tangent of loss angle ($\tan \delta$).....	21

4.4.3	Insulation resistance (R_i)	21
4.4.4	Voltage proof	22
4.5	Temperature characteristic of capacitance	23
4.5.1	Special preconditioning	23
4.5.2	Measuring conditions	23
4.5.3	Requirements	23
4.6	Robustness of terminations	23
4.7	Resistance to soldering heat	23
4.7.1	General	23
4.7.2	Special preconditioning	24
4.7.3	Initial measurement	24
4.7.4	Recovery	24
4.7.5	Final inspection, measurements and requirements	24
4.8	Solderability	24
4.8.1	General	24
4.8.2	Test conditions	24
4.8.3	Final inspection, measurements and requirements	24
4.9	Rapid change of temperature (if required)	24
4.9.1	General	24
4.9.2	Special preconditioning	24
4.9.3	Initial measurement	25
4.9.4	Test conditions	25
4.9.5	Recovery	25
4.10	Vibration	25
4.10.1	General	25
4.10.2	Test conditions	25
4.10.3	Final inspection, measurements and requirements	25
4.11	Bump (repetitive shock)	25
4.11.1	General	25
4.11.2	Initial measurements	25
4.11.3	Test conditions	25
4.11.4	Final inspection, measurements and requirements	26
4.12	Shock (non-repetitive shock)	26
4.12.1	General	26
4.12.2	Initial measurements	26
4.12.3	Test conditions	26
4.12.4	Final inspection, measurements and requirements	26
4.13	Climatic sequence	27
4.13.1	General	27
4.13.2	Special preconditioning	27
4.13.3	Initial measurements	27
4.13.4	Dry heat	27
4.13.5	Damp heat, cyclic, Test Db, first cycle	27
4.13.6	Cold	27
4.13.7	Low air pressure	27
4.13.8	Damp heat, cyclic, Test Db, remaining cycles	28
4.14	Damp heat, steady state	28
4.14.1	General	28
4.14.2	Special preconditioning	28

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[IEC 60384-9:2015](https://standards.iteh.ai/catalog/standards/sist/ed146591-cc4c-40e7-9bae-d48027acfe63/iec-60384-9-2015)

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4.14.3	Initial measurement	29
4.14.4	Test conditions	29
4.14.5	Recovery	29
4.14.6	Final inspection, measurements and requirements.....	29
4.15	Endurance	30
4.15.1	General	30
4.15.2	Special preconditioning.....	30
4.15.3	Initial measurement	30
4.15.4	Test conditions	30
4.15.5	Recovery	30
4.15.6	Final inspection, measurements and requirements.....	30
4.16	Component solvent resistance (if applicable)	31
4.17	Solvent resistance of the marking (if applicable)	31
Annex A (informative) Capacitance ageing of fixed capacitors of ceramic dielectric, Class 2.....		32
A.1	General.....	32
A.2	Law of capacitance ageing.....	32
A.3	Capacitance measurements and capacitance tolerance (see 4.4.1).....	33
A.4	Special preconditioning (see 4.2).....	33
Bibliography.....		35

iTeh STANDARD PREVIEW

Table 1 – Preferred tolerance on nominal capacitance	11
Table 2 – Preferred values of temperature characteristics.....	11
Table 3 – Sampling plan together with numbers of permissible non-conforming items for qualification approval tests, assessment level EZ.....	14
Table 4 – Test schedule for qualification approval.....	15
Table 5 – Lot-by-lot inspection	19
Table 6 – Periodic tests	20
Table 7 – Measuring conditions	21
Table 8 – Insulation resistance requirements	22
Table 9 – Test voltages.....	22
Table 10 – Details of measuring conditions	23
Table 11 – Maximum capacitance change.....	24
Table 12 – Preferred severities (of non-repetitive shock)	26
Table 13 – Maximum capacitance change.....	27
Table 14 – Number of damp heat cycles	28
Table 15 – Final inspection measurements and requirements	28
Table 16 – Test conditions for damp heat, steady state.....	29
Table 17 – Final inspection, measurements and requirements	29
Table 18 – Endurance test conditions	30
Table 19 – Final inspection, measurements and requirements	30

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

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International Standard IEC 60384-9 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This fourth edition cancels and replaces the third edition published in 2005. This fourth edition is a result of maintenance activities related to the previous edition. All changes that have been agreed upon can be categorized as minor revisions.

The text of this standard is based on the following documents:

FDIS	Report on voting
40/2339/FDIS	40/2364/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

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

1 General

1.1 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.

1.2 Object

The object of this standard is to prescribe preferred ratings and characteristics and to select from IEC 60384-1:2008 the appropriate quality assessment procedures, tests and measuring methods and to give general performance requirements for this type of capacitor. Test severities and requirements prescribed in detail specifications referring to this sectional specification shall be of equal or higher performance level because lower performance levels are not permitted.

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1.3 Normative references

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The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60063:1963, *Preferred number series for resistors and capacitors*
IEC 60063:1963/AMD1:1967
IEC 60063:1963/AMD2:1977

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60384-1:2008, *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*

1.4 Information to be given in a detail specification

1.4.1 General

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 information given in 1.4.2 may for convenience, be presented in tabular form.

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.

1.4.2 Outline drawing and dimensions

There shall be 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 in the detail specification. All dimensions shall preferably be stated in millimetres, however when the original dimensions are given in inches, the converted metric dimensions in millimetres shall be added.

Normally, the numerical values shall be given for the length of the body, the width and height of the body and the wire spacing, or for cylindrical types, the body diameter, and the length and diameter of the terminations. When necessary, for example when a number of items (capacitance values/voltage ranges) 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 described above, the detail specification shall state such dimensional information as will adequately describe the capacitors. When the capacitor is not designed for use on printed boards, this shall be clearly stated in the detail specification.

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1.4.3 Mounting

The detail specification shall specify the method of mounting to be applied for normal use and for the application of the vibration and the bump or shock tests. The design of the capacitor may be such that special mounting fixtures are required in its use. In this case, the detail specification shall describe the mounting fixtures and they shall be used in the application of the vibration and the bump or shock tests.

1.4.4 Ratings and characteristics

1.4.4.1 General

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

1.4.4.2 Nominal capacitance range

See 2.2.4.1.

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 the register of approvals".

1.4.4.3 Particular characteristics

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

1.4.4.4 Soldering

The detail specification shall prescribe the test methods, severities and requirements applicable for the solderability and the resistance to soldering heat tests.

1.4.5 Marking

The detail specification shall specify the content of the marking on the capacitor and on the packaging. Deviations from 1.6 shall be specifically stated.

1.5 Terms and definitions

For the purposes of this document, the applicable terms and definitions of IEC 60384-1 as well as the following apply.

1.5.1

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).

1.5.2

subclass

maximum percentage change of capacitance within the category temperature range with respect to the capacitance at 20 °C

Note 1 to entry: The subclass may be expressed in code form (see Table 2).

1.5.3

rated voltage

U_R

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

Note 1 to entry: Maximum d.c. voltage is the sum of the d.c. voltage and peak a.c. voltage or peak pulse voltage applied to the capacitor.

[SOURCE: IEC 60384-1:2008, 2.2.25, modified (addition of "the terminations of")]

1.6 Marking

1.6.1 General

See IEC 60384-1:2008, 2.4, with the following details:

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:

- a) nominal capacitance;
- b) rated voltage (d.c. voltage may be indicated by the symbol $\overline{\text{---}}$ or ---);
- c) tolerance on nominal capacitance;
- d) the dielectric subclass, see Table 2;
- e) year and month (or week) of manufacture;
- f) manufacturer's name or trade mark;
- g) climatic category;

- h) manufacturer's type designation;
- i) reference to the detail specification.

Information required under b) and d) may be given in code form under manufacturer's, or national, type or style designation.

1.6.2 Marking on the body

The capacitor shall be clearly marked with a), b) and c) of 1.6.1 and with as many as possible of the remaining items as is considered necessary. Any duplication of information in the marking on the capacitor should be avoided.

1.6.3 Marking of the packaging

The packaging containing the capacitor(s) shall be clearly marked with all the information listed in 1.6.1.

1.6.4 Additional marking

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

2 Preferred ratings and characteristics

2.1 Preferred characteristics

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

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

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.

2.2 Preferred values of ratings

2.2.1 Rated temperature

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

2.2.2 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 d.c. voltage and the peak a.c. voltage applied to the capacitor should not exceed the rated voltage. The value of the peak alternating voltage should not exceed the value determined by the permissible reactive power.

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 IEC 60384-1:2008, 2.2.5.

2.2.4 Preferred values of nominal capacitance and associated tolerance values

2.2.4.1 Preferred values of nominal capacitance

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

2.2.4.2 Preferred tolerances on nominal capacitance

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

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

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2.2.5 Temperature characteristic of capacitance

IEC 60384-9:2015

Table 2 denotes with a cross the preferred values of temperature characteristics with and without d.c. voltage applied. The method of coding the subclass is also given; for example a dielectric with a percentage change of ±20 % without d.c. voltage applied over the temperature range from -55 °C to +125 °C, will be defined as a dielectric of Class 2C1.

Table 2 – Preferred values of temperature characteristics

Sub-class letter code	Maximum capacitance change in per cent 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 °C	-55/+85 °C	-40/+85 °C	-25/+85 °C	-10/+85 °C
	Without d.c. voltage applied	With d.c. voltage applied ^a	1	2	3	4	6
2B	±10	As specified in the detail specification	-	x	x	x	-
2C	±20		x	x	x	-	-
2D	+20/-30		-	-	-	x	-
2E	+22/-56		-	x	x	x	x
2F	+30/-80		-	x	x	x	x
2R	±15		x	-	-	-	-
2X	±15	+15/-25	x	-	-	-	-

NOTE x indicates: applied;
- indicates: not applied.

^a The applied voltage is the rated d.c. voltage or as specified in the detail specification.

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

3 Quality assessment procedures

3.1 Primary stage of manufacture

For single layer capacitors, the primary stage of manufacture is the metallizing of the dielectric to form the electrode; for multilayer capacitors it 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 values.

3.3 Certified test records of released lots

The information required in IEC 60384-1:2008, Q.9, 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 change, $\tan \delta$ and the insulation resistance.

3.4 Qualification approval

3.4.1 General

The procedures for qualification approval testing are given in IEC 60384-1:2008, Q.5.

The schedule to be used for qualification approval testing on the basis of lot-by-lot and periodic tests is given in 3.5. The procedure using a fixed sample size schedule is given in 3.4.2 and 3.4.3.

3.4.2 Qualification approval on the basis of the fixed sample size procedure

The fixed sample size procedure is described in IEC 60384-1:2008, Q.5.3 b). 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.

The samples shall consist of specimens having the lowest and highest voltages, and for these voltages the lowest and highest capacitance values. 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). When the range consists of less than four values, the number of specimens to be tested shall be that required for four values.

Spare specimens are permitted as follows:

Two (for six values) or three (for four values) per value may be used as replacements for specimens which are non-conforming because of incidents not attributable to the manufacturer.

The numbers given in Group 0 assume that all groups are applicable. If this is not so, the numbers may be reduced accordingly.

When additional groups are introduced into the qualification approval test schedule, the number of specimens required for Group 0 shall be increased by the same number as that required for the additional groups.

Table 3 gives the number of samples to be tested in each group or subgroup together with the number of permissible non-conformances for qualification approval tests.

3.4.3 Tests

The complete series of tests specified in Table 3 and Table 4 are required for the approval of capacitors covered by one detail specification. The tests of each group shall be carried out in the order given.

The whole sample shall be subjected to the tests of Group 0 and then divided for the other groups.

Non-conforming specimens found during the tests of Group 0 shall not be used for the other groups.

“One non-conforming item” is counted when a capacitor has not satisfied the whole or a part of the tests of a group.

The approval is granted when the number of non-conforming items is zero.

Tables 3 and 4 together form the fixed sample size test schedule for which Table 3 includes the details for the sampling and permissible non-conforming item for the different tests or groups of test, whereas Table 4 together with the details of test contained in Clause 4 gives a complete summary of test conditions and performance requirements and indicates where, for example for the test method or conditions of test, a choice has to be made in the detail specification.

The conditions of test and performance requirements for the fixed sample size test schedule shall be identical to those prescribed in the detail specification for quality conformance inspection.

IEC 60384-9:2015
<https://standards.iteh.ai/catalog/standards/sist/ed146591-ec4c-40e7-9bae-d48027acfe63/iec-60384-9-2015>

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