

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

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

IEC 60384-8:2005

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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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International Standard IEC 60384-8 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This third edition cancels and replaces the second edition published in 1988, amendment 1 (1993) and amendment 2 (2000). This third 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.

This bilingual version (2011-11) corresponds to the monolingual English version, published in 2005-05.

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

FDIS	Report on voting
40/1528/FDIS	40/1548/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.

The French version of this standard has not been voted upon.

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

IEC 60384 consists of the following parts, under the general title *Fixed capacitors for use in electronic equipment*:

- Part 1: Generic specification
- Part 2: Sectional specification: Fixed metallized polyethylene-terephthalate film dielectric d.c. capacitors
- Part 3: Sectional specification: Fixed tantalum chip capacitors
- Part 4: Sectional specification: Aluminium electrolytic capacitors with solid and non-solid electrolyte
- Part 5: Sectional specification: Fixed mica dielectric d.c. capacitors with a rated voltage not exceeding 3000 V – Selection of methods of test and general requirements
- Part 6: Sectional specification: Fixed metallized polycarbonate film dielectric d.c. capacitors
- Part 7: Sectional specification: Fixed polystyrene film dielectric metal foil d.c. capacitors
- Part 8: Sectional specification: Fixed capacitors of ceramic dielectric, Class 1
- Part 9: Sectional specification: Fixed capacitors of ceramic dielectric, Class 2
- Part 10: Sectional specification: Fixed polyethylene-terephthalate film dielectric metal foil d.c. capacitors
- Part 11: Sectional specification: Fixed polyethylene-terephthalate film dielectric metal foil d.c. capacitors
- Part 12: Sectional specification: Fixed polycarbonate film dielectric metal foil d.c. capacitors
- Part 13: Sectional specification: Fixed polypropylene film dielectric metal foil d.c. capacitors
- Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains
- Part 15: Sectional specification: Fixed tantalum capacitors with non-solid or solid electrolyte
- Part 16: Sectional specification: Fixed metallized polypropylene film dielectric d.c. capacitors
- Part 17: Sectional specification: Fixed metallized polypropylene film dielectric a.c. and pulse capacitors
- Part 18: Sectional specification: Fixed aluminium electrolytic chip capacitors with solid and non-solid electrolyte
- Part 19: Sectional specification: Fixed metallized polyethylene-terephthalate film dielectric chip d.c. capacitors
- Part 20: Sectional specification: Fixed metallized polyphenylene sulfide film dielectric chip d.c. capacitors
- Part 21: Sectional specification: Fixed surface mount multilayer capacitors of ceramic dielectric, Class 1

- Part 22: Sectional specification: Fixed surface mount multilayer capacitors of ceramic dielectric, Class 2
- Part 23: Sectional specification: Fixed surface mount metallized polyethylene naphthalate film dielectric d.c. capacitors¹
- Part 24: Sectional specification – Surface mount fixed tantalum electrolytic capacitors with conductive polymer solid electrolyte^①
- Part 25: Sectional specification – Surface mount fixed aluminium electrolytic capacitors with conductive polymer solid electrolyte^①

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
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¹ To be published.

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 8: Sectional specification: Fixed capacitors of ceramic dielectric, Class 1

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 1), intended for use in electronic equipment, including leadless capacitors but excluding fixed surface mount multilayer capacitors of ceramic dielectric.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 60384-1:1999, 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.

1.3 Normative references

The following referenced documents are indispensable for the application 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 60063:1963, *Preferred number series for resistors and capacitors*
Amendment 1 (1967)
Amendment 2 (1977)

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

IEC 60384-1:1999, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 60384-14, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

ISO 3:1973, *Preferred numbers – Series of preferred numbers*

² Which are covered by IEC 60384-21 (Class 1).

1.4 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.

NOTE The information given in 1.4.1 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.

1.4.1 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.

1.4.2 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 capacitors shall be mounted by their normal means. 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 bump or shock tests.

1.4.3 Ratings and characteristics

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

1.4.3.1 Rated capacitance range

See 2.2.4.1

NOTE When products approved to the detail specification have different ranges, the following statement should be added: "The range of values available in each voltage range is given in IEC QC 001005".

1.4.3.2 Particular characteristics

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

1.4.3.3 Soldering

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

1.4.4 Marking

The detail specification shall specify the content of the marking on the capacitor and on the package. 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 and the following apply.

1.5.1

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

1.5.2

subclass

for a given rated temperature coefficient, it is defined by the rated tolerance on the temperature coefficient (see Table 2)

NOTE The rated temperature coefficient value and its tolerance refer to the temperature interval of +20 °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). 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.

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 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.

1.6 Marking

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

1.6.1 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:

- rated capacitance;
- rated voltage (d.c. voltage may be indicated by the symbol --- or —);
- tolerance on rated capacitance;

- d) temperature coefficient and, space permitting, its tolerance in code, 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.

NOTE Information required under 1.6.1 b) and 1.6.1 d) may be given in code form under manufacturer's, or national, type or style designation.

1.6.2 Coding of temperature coefficient is given in Table 2. In case of colour code spot, stripe or ring may be used; moreover for temperature coefficients, where two colours are required, the second colour may be provided by the colour of the body or of the typographical marking.

1.6.3 The capacitor shall be clearly marked with a), b) and c) 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.

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

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

2 Preferred ratings and characteristics

2.1 Preferred characteristics

The values given in detail specifications shall preferably be selected from the following:

2.1.1 Preferred climatic categories

The capacitors covered by this specification are classified into climatic categories according to the general rules given in IEC 60068-1.

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:	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 specification, 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 and 4 000 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.

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, 2.2.17.

2.2.4 Preferred values of rated capacitance and associated tolerance values

2.2.4.1 Preferred values of rated capacitance

Rated capacitance values shall be taken from the series of IEC 60063, the E6, E12 and E24 series are preferred.

2.2.4.2 Preferred tolerances on rated capacitance

Table 1 – Preferred tolerances on rated capacitance

Preferred series	$C_R \geq 10 \text{ pF}$		$C_R < 10 \text{ pF}$	
	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

2.2.5 Temperature coefficient (α)

2.2.5.1 Table 2 shows the preferred rated temperature coefficient and the associated tolerances, expressed in parts per million per Kelvin ($10^{-6}/\text{K}$), and the corresponding subclasses 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 these minimum values:

- 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;
- Special methods of measurement may be necessary and, if required, shall be stated in the detail specification.

2.2.5.2 Figures A.1 to A.15 show the limits of variation of capacitance with temperature for the temperature coefficients and subclasses listed in Table 2.

Table 2 – Rated temperature coefficient and tolerances

Rated 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
<u>0</u>	± 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
<u>-150</u>	± 15 ± 30 ± 60	1A 1B 1E	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
<u>-750</u>	± 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	$\pm 1 000$	1F	E	M	Blue + Orange
-5 600	$\pm 1 000$	1F	F	M	Black + Orange
$+140 \geq \alpha \geq -1 000$	^a	1C	SL	-	Grey
$+250 \geq \alpha \geq -1 750$	^a	1D	UM	-	White

NOTE 1 Preferred temperature coefficient values (α) are underlined.

NOTE 2 α values $+33 \times 10^{-6}/K$ and $-47 \times 10^{-6}/K$ may also be obtained on request.

NOTE 3 The rated temperature coefficients and their tolerances are defined using the capacitance change between the temperatures 20 °C and 85 °C.

NOTE 4 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 designed 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.