

Harmonized system of quality assessment for electronic components

Sectional specification:

Fixed multilayer ceramic chip capacitors

Système Harmonisé d'Assurance de la Qualité
des Composants Electroniques
Specification Intermediaire:
Condensateurs fixes chipses a dielectrique en
ceramique multicouche

Harmonisiertes Gütebestätigungssystem für
Bauelemente der Elektronik
Rahmenspezifikation:
Vielschichtkeramik- chip-kondensatoren

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Electronic Components Standards Policy Committee (ECL/-) to Technical Committee ECL/4, upon which the following bodies were represented:

British Telecommunications plc
EEA (The Association of Electronics, Telecommunications and Business Equipment Industries)
Electronic Components Industry Federation
Ministry of Defence
National Supervising Inspectorate
Society of British Aerospace Companies Limited

This British Standard, having been prepared under the direction of the Electronic Components Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on
15 August 1992

© BSI 1992

The following BSI references relate to the work on this standard:
Committee reference ECL/4
Draft announced in *BSI News*
September 1990

ISBN 0 580 19408 6

Amendments issued since publication

Amd. No.	Date	Text affected

National foreword

This British Standard has been prepared under the direction of the Electronic Components Standards Policy Committee. It is identical with CECC 32100 : 1988 'Harmonized system of quality assessment for electronic components. Sectional specification: fixed multilayer ceramic chip capacitors' published by the Electronic Components Committee (CECC) of the European Committee for Electrotechnical Standardization (CENELEC).

This standard is a harmonized specification within the CECC system and should be read in conjunction with BS CECC 30000 : 1984 'Harmonized system of quality assessment for electronic components: generic specification: fixed capacitors'.

Cross-references

The British Standard which implements CECC 00100 is BS 9000 'General requirements for a system for electronic components of assessed quality' Part 2 : 1991 'Specification for the national implementation of the CECC system'.

International Standard	Corresponding British Standard
ISO 3 : 1973	BS 2045 : 1965 Preferred numbers (Technically equivalent)
IEC 62 : 1974	BS 1852 : 1975 Specification for marking codes for resistors and capacitors (Identical)
IEC 63 : 1974	BS 2488 : 1966 Schedule of preferred numbers for the resistance of resistors and the capacitance of capacitors for telecommunications equipment (Technically equivalent)
IEC 68-1 : 1988	BS 2011 Environmental testing Part 1.1 : 1989 General and guidance (Identical)
IEC 68-2-20 : 1979	Part 2.1T : 1981 Test T. Soldering (Identical)
IEC 68-2-45 : 1980	Part 2.1XA : 1981 Test XA and guidance. Immersion in cleaning solvents (Identical)
IEC 249-2-5 : 1987	BS 4584 Metal-clad base materials for printed wiring boards Section 102.5 : 1990 Specification for epoxide woven glass fabric copper-clad laminated sheet of defined flammability (vertical burning test) (Identical)
IEC 326-3 : 1991	BS 6221 Printed wiring boards Part 3 : 1991 Guide for the design and use of printed wiring boards (Identical)
IEC 410 : 1973	BS 6001 Sampling procedures for inspection by attributes Part 1 : 1991 Specification for sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection (Technically equivalent)
CECC 30000 : 1983	BS CECC 30000 : 1984 Harmonized system of quality assessment for electronic components: generic specification: fixed capacitors (Identical)

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Förderverein für Elektrotechnische Normung (FEN) e. V.
Cenelec Electronic Components Committee

CECC



**Système Harmonisé d'Assurance de la Qualité
des Composants Electroniques**

SPECIFICATION INTERMEDIAIRE:

**CONDENSATEURS FIXES
CHIPS A DIELECTRIQUE
EN CERAMIQUE
MULTICOUCHE**

**Harmonized System of Quality Assessment for
Electronic Components**

SECTIONAL SPECIFICATION:

**FIXED MULTILAYER
CERAMIC CHIP
CAPACITORS**

**Harmonisiertes Gütebestätigungssystem für
Bauelemente der Elektronik**

RAHMENSPEZIFIKATION:

**VIELSCHICHTKERAMIK-
CHIP-KONDENSATOREN**

1

**Edition
Issue
Ausgabe**

CECC 32 100

CONTENTS

	<u>Page</u>
FOREWORD	2
PREFACE	2
Clause	
SECTION 1 - GENERAL	3
1.1 Scope	3
1.2 Related documents	3
1.3 Information to be given in a detail specification	3
1.4 Terminology	5
1.5 Marking	6
SECTION 2 - PREFERRED RATINGS AND CHARACTERISTICS	8
2.1 Preferred climatic categories	8
2.2 Preferred values of ratings	8
SECTION 3 - QUALITY ASSESSMENT PROCEDURES	13
3.1 Primary stage of manufacture	13
3.2 Structurally similar components	13
3.3 Certified test records	13
3.4 Qualification approval	13
3.5 Quality conformance inspection	15
SECTION 4 - TESTS AND MEASURING METHODS	20
4.1 Special preconditioning	20
4.2 Preliminary drying	20
4.3 Measuring conditions	20
4.4 Mounting	20
4.5 Visual examination and check of dimensions	23
4.6 Electrical tests	24
4.7 Variation of capacitance with temperature	28
4.8 Adhesion	30
4.9 Bond strength of end face plating	30
4.10 Resistance to soldering heat	31
4.11 Solderability	33
4.12 Rapid change of temperature	35
4.13 Climatic sequence	36
4.14 Damp heat, steady state	38
4.15 Endurance	40
4.16 Robustness of terminations	41
ANNEX A : Test schedule for Qualification Approval	42
ANNEX B : Capacitance ageing of fixed capacitors of ceramic dielectric class 2	47

FOREWORD

The CENELEC Electronic Components Committee (CECC) is composed of those member countries of the European Committee for Electrotechnical Standardization (CENELEC) who wish to take part in a harmonized System for electronic components of assessed quality.

The object of the System is to facilitate international trade by the harmonization of the specifications and quality assessment procedures for electronic components, and by the grant of an internationally recognized Mark, or Certificate, of Conformity. The components produced under the System are thereby accepted by all member countries without further testing.

This specification has been formally approved by the CECC, and has been prepared for those countries taking part in the System who wish to issue national harmonized specifications for FIXED MULTILAYER CERAMIC CHIP CAPACITORS. It should be read in conjunction with the current regulations for the CECC System.

At the date of printing of this specification the member countries of the CECC are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom, and copies of it can be obtained from the addresses shown on the blue fly-sheet.

PREFACE

This sectional specification was prepared by CECC WG 3: "Capacitors".

It is based, wherever possible, on the Publications of the International Electrotechnical Commission and in particular on IEC 384-10: Part 10: Sectional specification: Fixed multilayer ceramic chip capacitors. Selection of methods of test and general requirements.

The text of this sectional specification was circulated to the CECC for voting in the documents listed below and was ratified by the President of the CECC for printing as a CECC Specification.

<u>Documents</u>	<u>Voting Date</u>	<u>Reports on the Voting</u>
CECC(Secretariat)1885	February 1986	CECC(Secretariat)2007
CECC(Secretariat)2042	February 1987	CECC(Secretariat)2135

SECTION 1 – GENERAL

1.1 Scope

This specification applies to fixed unencapsulated multilayer chip capacitors of ceramic dielectric class 1 and class 2 with rated voltage normally not exceeding 200 V, for use in electronic equipment. 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.

It prescribes preferred ratings and characteristics and selects from CECC 30 000 the appropriate quality assessment procedures, tests and measuring methods and gives 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.

1.2 Related documents

ISO 3	(1973)	Preferred numbers – Series of preferred numbers
IEC 62	(1974)	Marking codes for resistors and capacitors
IEC 63	(1963)	Preferred number series for resistors and capacitors
Amendment No. 1	(1967)	
Amendment No. 2	(1977)	
IEC 68		Basic environmental testing procedures
CECC 30 000 Issue 3	(1983)	Generic specification: Fixed capacitors
IEC 410	(1973)	Sampling plans and procedures for inspection by attributes

Note: The above references apply to the current editions except for IEC 68.

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.

Note: The information given in 1.3.1 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.

1.3.1 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 are preferably to be stated in mm.

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 is 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) 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 the Qualified Products List".

(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 shall be specifically stated.

1.4 Terminology

In addition to the applicable terms and definitions of CECC 30 000 the following definitions apply:

1.4.1 Chip 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 dielectric class 1

- (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).

- (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) 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).
- (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 code form (see Table 5 in 2.2.6).

1.4.4 Rated voltage (U_R)

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

Note: The sum of the d.c. voltage and the peak a.c. 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 CECC 30 000 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 Chip capacitors are generally not marked on the body. If some marking can be applied, they shall be clearly marked with as many as possible of the above items as is considered useful. Any duplication of information in the marking on the capacitor should be avoided.
- 1.5.3 The marking shall be legible and not easily smeared or removed by rubbing with the finger.
- 1.5.4 The package containing the capacitor(s) shall be marked with all the information listed in 1.5.1.
- 1.5.5 Any additional marking shall be so applied that no confusion can arise.

SECTION 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 the upper category temperatures respectively.

Note: The resistance to humidity resulting from the above climatic category is for the chip in its unmounted state. The climatic performance of the chip 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 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 2.2.17 of CECC 30 000.

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			
	$C_R \geq 10 \text{ pF}$	Letter code	$C_R < 10 \text{ pF}$	Letter code
E6	$\pm 20 \%$	M	$\pm 2 \text{ pF}$	G
E12	$\pm 10 \%$	K	$\pm 1 \text{ pF}$	F
E24	$\pm 5 \%$	J	$\pm 0,5 \text{ pF}$	D
	$\pm 2 \%$	G	$\pm 0,25 \text{ pF}$	C
	$\pm 1 \%$	F	$\pm 0,1 \text{ pF}$	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

- (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:

- a) 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.
- b) Special methods of measurement may be necessary and if required shall be stated in the detail specification.

Table 3

Rated temperature coefficient ($10^{-6}/^{\circ}\text{C}$)	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	-

- Notes
1. Preferred temperature coefficients (α) are underlined.
 2. The rated temperature coefficients and their tolerances are defined using the capacitance change between the temperatures 20 $^{\circ}\text{C}$ and 85 $^{\circ}\text{C}$.
 3. A capacitor with a temperature coefficient of zero and a tolerance on T.C. of $\pm 30 \cdot 10^{-6}/^{\circ}\text{C}$ is designated as a CG capacitor (Sub-class 1B).