

Harmonized system of quality
assessment for electronic components

Fixed capacitors for use in electronic equipment — Sectional specification: Aluminium electrolytic capacitors with solid and non-solid electrolyte

ICS 31.060.50

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Document Sharing Hub

This British Standard, having been prepared under the direction of the Electrotechnical Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 December 1998

© BSI 06-1999

ISBN 0 580 30622 4

Amendments issued since publication

Amd. No.	Date	Comments

Contents

	Page
National foreword	ii
Text of CEI IEC 60384-4	1

National foreword

This British Standard reproduces verbatim IEC 60384-4:1998 and implements it as the UK national standard. It supersedes BS 9930-03.0:1988 which will be withdrawn on 31-12-98. This standard is a harmonized specification within the IEC system of quality assessment for electronic components (IECQ).

The UK participation in its preparation was entrusted by Technical Committee EPL/40, Capacitors and resistors for electronic equipment, to Subcommittee EPL/40/1, Capacitors and EMI suppression components for electronic equipment, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

The standard is to be used in conjunction with BS QC 300000:1983, *Harmonized system of quality assessment for electronic components: Fixed capacitors for use in electronic equipment: Generic specification*.

The British Standard which implements the IECQ Rules of Procedure is BS 9000-3:1996, *General requirements for a system for electronic components of assessed quality — Part 3: Specification for the national implementation of the IECQ system*.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the CEI IEC title page, page ii, pages 1 to 25 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

**NORME
INTERNATIONALE
INTERNATIONAL
STANDARD**

**CEI
IEC**

60384-4

QC 300300

Troisième édition
Third edition
1998-07

**Condensateurs fixes utilisés dans
les équipements électroniques –**

Partie 4:

Spécification intermédiaire:

**Condensateurs électrolytiques à l'aluminium
à électrolyte solide et non solide**

Fixed capacitors for use in electronic equipment –

Part 4:

Sectional specification:

**Aluminium electrolytic capacitors with solid
and non-solid electrolyte**



Numéro de référence
Reference number
CEI/IEC 60384-4:1998

Contents

	Page
Section 1. General	
1 General	1
1.1 Scope	1
1.2 Object	1
1.3 Normative references	1
1.4 Information to be given in a detail specification	1
1.5 Terminology	2
1.6 Marking	3
Section 2. Preferred ratings and characteristics	
2 Preferred ratings and characteristics	3
2.1 Preferred characteristics	3
2.2 Preferred values of ratings	3
Section 3. Quality assessment procedures	
3 Quality assessment procedures	4
3.1 Primary stage of manufacture	4
3.2 Structurally similar components	4
3.3 Certified records of released lots	4
3.4 Qualification approval	5
3.5 Quality Conformance Inspection	16
Section 4. Test and measurement procedures	
4 Test and measurement procedures	18
4.1 Pre-conditioning (for non-solid electrolyte capacitors only)	18
4.2 Visual examination and check of dimensions	18
4.3 Electrical tests	18
4.4 Robustness of terminations	20
4.5 Resistance to soldering heat	20
4.6 Solderability	21
4.7 Rapid change of temperature	21
4.8 Vibration	21
4.9 Bump	21
4.10 Shock	22
4.11 Climatic sequence	22
4.12 Damp heat, steady state	23
4.13 Endurance	23
4.14 Surge	23
4.15 Reverse voltage (if required by the detail specification)	24
4.16 Pressure relief (if required by the detail specification)	24
4.17 Storage at high temperature	24
4.18 Storage at low temperature (for non-solid electrolyte capacitors only)	25
4.19 Characteristics at high and low temperature	25
4.20 Charge and discharge (if required by the detail specification)	25
4.21 High surge current (for solid electrolyte capacitors only and if required by the detail specification)	25
Table 1 — Sampling plan together with numbers of permissible defectives for qualification approval tests	6
Table 2 — Test schedule for Qualification Approval	7
Table 3a	17
Table 3b	18
Table 4	19

Section 1. General

1 General

1.1 Scope

This standard applies to aluminium electrolytic capacitors with solid and non-solid electrolyte primarily intended for d.c. applications for use in electronic equipment. It covers capacitors for long-life applications and capacitors for general-purpose applications.

Capacitors for special-purpose applications may need additional requirements.

1.2 Object

The object of this standard is to prescribe preferred ratings and characteristics and to select from IEC 60384-1, 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 normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60384. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 60384 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60062:1992, *Marking codes for resistors and capacitors*.

IEC 60063:1963, *Preferred number series for resistors and capacitors*.

Amendment 1 (1967)

Amendment 2 (1977)

IEC 60068, — *Environmental testing*.

IEC 60384-1:1982, *Fixed capacitors for use in electronic equipment — Part 1: Generic specification*.

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

IEC QC 001001:1981, *Basic rules of the IEC Quality Assessment System for Electronic Components (IECQ)*.

IEC QC 001002:1981, *Rules of procedure of the IEC Quality Assessment System for Electronic Components (IECQ)*.

ISO 3:1973, *Preferred numbers — Series of preferred numbers*.

NOTE The above references apply to the current editions except for IEC 60068, for which the referenced edition in the applicable test clauses of the generic specification shall be used.

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 14.1.1 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 capacitor. 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 2.2.1.

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 the qualified products list."

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 test.

1.4.4 Marking

The detail specification shall specify the content of the marking on the capacitor and on the package. Deviations in 1.6 of this sectional specification shall be specifically stated.

1.5 Terminology

In addition to the applicable terms and definitions of IEC 60384-1 the following definitions apply:

1.5.1

capacitance of an electrolytic capacitor

capacitance of an equivalent circuit having capacitance and resistance in series measured with alternating current approximately sinusoidal waveform at a specified frequency

1.5.2

long-life grade capacitors

capacitors intended for applications where a high degree of stability of characteristics over a long life is essential

the materials are so chosen and the manufacture carried out so that improved performance is obtained with consequent increase in life

1.5.3

general-purpose grade capacitors

capacitors intended for applications where the high performance level of long-life grade capacitors is not required

1.5.4

reverse voltage (for polar capacitors only)

voltage applied to the capacitor terminals in the reverse polarity direction

1.6 Marking

According to 2.4 of IEC 60384-1, 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:

- a) rated capacitance;
- b) rated voltage (d.c. voltage may be indicated by the symbol: $\overline{\text{---}}$ or ---);
- c) category voltage and category temperatures (for long-life grade capacitors only);
- d) polarity of the terminations.

For multi-section capacitors, the rated capacitance and rated voltage of the sections connected to each termination shall be shown in an unambiguous way. The termination of a capacitor section which is intended for direct connection to the rectifier (so-called reservoir section) shall be marked with the number 1 or with the colour red;

- e) tolerance on rated capacitance;
- f) reference to the grade (for long-life grade capacitors only).

The abbreviation LL may be used for marking purposes;

- g) year and month (or week) of manufacture;
- h) manufacturer's name or trade mark;
- i) climatic category;
- j) manufacturer's type designation;
- k) reference to the detail specification.

1.6.2 The capacitor shall be clearly marked with a), b), c), d), e) and f) above 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 The package containing the capacitor(s) shall be clearly marked with all the information listed in 1.6.1.

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

Section 2. Preferred ratings and characteristics

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 temperature and the duration of the damp heat, steady state test shall be chosen from the following:

Lower category temperature: $-55\text{ }^{\circ}\text{C}$, $-40\text{ }^{\circ}\text{C}$, $-25\text{ }^{\circ}\text{C}$ and $-10\text{ }^{\circ}\text{C}$.

Upper category temperature: $+85\text{ }^{\circ}\text{C}$, $+100\text{ }^{\circ}\text{C}$, $+105\text{ }^{\circ}\text{C}$ and $+125\text{ }^{\circ}\text{C}$.

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 capacitance (C_N or C_R)

Preferred values of rated capacitance are chosen from the E3 series of IEC 60063 and their decimal multiples.

If other values are needed, they shall preferably be chosen from the E6 series.

2.2.2 Tolerance on rated capacitance

Preferred values of tolerances on rated capacitance are:

– 10/ + 10 %	– 10/ + 75 %
– 10/ + 30 %	– 10/ + 100 %
– 10/ + 50 %	– 20/ + 20 %

2.2.3 Rated voltage (U_N or U_R)

Preferred values of rated direct voltages taken from the R5 and R10 series of ISO 3 are:

For voltage values < 250 V:	1 V, 1,6 V, 2,5 V, 4 V, 6,3 V and their decimal multiples (R5 series)
For voltage values $\geq$ 250 V:	250 V, 315 V, 350 V, 400 V, 450 V (250 V, 315 V and 400 V are in accordance with the R10 series; 350 V and 450 V are permitted in addition).

2.2.4 Category voltage (U_C)

The category voltage is equal to the rated voltage, unless otherwise stated in the detail specification.

2.2.5 Ripple voltage

An alternating voltage may be applied provided that the peak voltage resulting from the alternating voltage superimposed on the direct voltage does not exceed the value of rated direct voltage and that the rated ripple current (see 2.2.8) and the permissible reverse voltage (see detail specification) are not exceeded.

2.2.6 Reverse voltage

The permissible reverse voltage shall be given in the detail specification.

2.2.7 Surge voltage ratio

The surge voltage shall be 1,15 times the rated or category voltage for rated voltages $\leq$ 315 V or 1,10 times the rated or category voltage for rated voltages > 315 V.

See also 4.14.

2.2.8 Rated ripple current

The rated ripple current at 100 Hz or 120 Hz and at upper category temperature shall be given in the detail specification. Alternatively, for capacitors for switched mode power supply application, the rated ripple current shall be stated at the relevant frequency.

NOTE This value is determined by the dimensions of the capacitor and several other factors, e.g. the tangent of loss angle and the permissible temperature rise.

See also 2.2.5.

Section 3. Quality assessment procedures

3 Quality assessment procedures

3.1 Primary stage of manufacture

For capacitors with solid electrolyte, the primary stage of manufacture is the etching or formation of the anode body.

For capacitors with non-solid electrolyte, the primary stage of manufacture is the capacitor manufacturer's evaluation of the formed anode foil.

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 records of released lots

The information required in 3.5.1 of IEC 60384-1 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 leakage current.