BSI Standards Publication

Fixed capacitors for use in electronic equipment

Part 22: Sectional specification – Fixed surface mount multilayer capacitors of ceramic dielectric, Class 2

bsi.

Documents
Document Sharing Hub

Full document details: BS EN IEC 60384-22:2019

National foreword

This British Standard is the UK implementation of EN IEC 60384-22:2019. It is identical to IEC 60384-22:2019. It supersedes BS EN 60384-22:2012, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/40X, Capacitors and resistors for electronic equipment.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2019
Published by BSI Standards Limited 2019

ISBN 978 0 580 97412 0

ICS 31.060.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2019.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS EN IEC 60384-22:2019

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 60384-22

March 2019

ICS 31.060.10

Supersedes EN 60384-22:2012

English Version

Fixed capacitors for use in electronic equipment - Part 22: Sectional specification - Fixed surface mount multilayer capacitors of ceramic dielectric, Class 2 (IEC 60384-22:2019)

Condensateurs fixes utilisés dans les équipements électroniques - Partie 22: Spécification intermédiaire - Condensateurs multicouches fixes à diélectriques en céramique pour montage en surface, de Classe 2 (IEC 60384-22:2019)

Festkondensatoren zur Verwendung in Geräten der Elektronik - Teil 22: Rahmenspezifikation - Oberflächenmontierbare Vielschichtkeramik-Festkondensatoren, Klasse 2 (IEC 60384-22:2019)

This European Standard was approved by CENELEC on 2019-03-05. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

© 2019 CENELEC All rights of exploitation in any form and by any means reserved worldwide for CENELEC Members.

Ref. No. EN IEC 60384-22:2019 E

AVA Documents Document Sharing Hub

Full document details: BS EN IEC 60384-22:2019

European foreword

The text of document 40/2640/FDIS, future edition 3 of IEC 60384-22, prepared by IEC/TC 40 "Capacitors and resistors for electronic equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60384-22:2019.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2019-12-05
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-03-05

This document supersedes EN 60384-22:2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 60384-22:2019 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 60384-14	NOTE	Harmonized as EN 60384-14

Documents
Document Sharing Hub

Full document details: BS EN IEC 60384-22:2019

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60063	-	Preferred number series for resistors and capacitors	EN 60063	-
IEC 60068-1	2013	Environmental testing - Part 1: General and guidance	EN 60068-1	2014
IEC 60068-2-58	2015	Environmental testing - Part 2-58: Tests - Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)	EN 60068-2-58	2015
+ A1	2017		+ A1	2018
IEC 60384-1	2016	Fixed capacitors for use in electronic equipment - Part 1: Generic specification	EN 60384-1	2016
IEC 61193-2	2007	Quality assessment systems - Part 2: Selection and use of sampling plans for inspection of electronic components and packages	EN 61193-2	2007
ISO 3	1973	Preferred numbers - Series of preferred numbers	-	-

Documents
Document Sharing Hub
Full document details: BS EN IEC 60384-22:2019

This page deliberately left blank

Documents
Document Sharing Hub

CONTENTS

FOREWORD 6
1 Scope 8
2 Normative references 8
3 Terms and definitions 8
4 Information to be given in a detail specification 9
4.1 General 9
4.2 Outline drawing and dimensions 10
4.3 Mounting 10
4.4 Rating and characteristics 10
4.4.1 General 10
4.4.2 Nominal capacitance range 10
4.4.3 Particular characteristics 10
4.4.4 Soldering 10
4.5 Marking 11
5 Marking 11
5.1 General 11
5.2 Information for marking 11
5.3 Marking on the body 11
5.4 Requirements for marking 11
5.5 Marking of the packaging 11
5.6 Additional marking 11
6 Preferred ratings and characteristics 11
6.1 Preferred characteristics 11
6.2 Preferred values of ratings 12
6.2.1 Rated temperature (T_R) 12
6.2.2 Rated voltage (U_R) 12
6.2.3 Category voltage (U_C) 12
6.2.4 Preferred values of nominal capacitance and associated tolerance values 12
6.2.5 Temperature characteristic of capacitance 13
6.2.6 Dimensions 13
7 Quality assessment procedures 14
7.1 Primary stage of manufacture 14
7.2 Structurally similar components 14
7.3 Certified records of released lots 14
7.4 Qualification approval 14
7.4.1 General 14
7.4.2 Qualification approval on the basis of the fixed sample size procedures 14
7.4.3 Tests 15
7.5 Quality conformance inspection 19
7.5.1 Formation of inspection lots 19
7.5.2 Test schedule 20
7.5.3 Delayed delivery 20
7.5.4 Assessment levels 20
8 Test and measurement procedures 21
8.1 General 21

AVA Documents Document Sharing Hub

Full document details: BS EN IEC 60384-22:2019

8.2 Special preconditioning 22
8.3 Measuring conditions 22
8.4 Mounting 22
8.5 Visual examination and check of dimensions 22
8.5.1 General 22
8.5.2 Visual examination 22
8.5.3 Requirements 22
8.6 Electrical tests 24
8.6.1 Capacitance 24
8.6.2 Tangent of loss angle (tan δ) 24
8.6.3 Insulation resistance 25
8.6.4 Voltage proof 26
8.6.5 Impedance (if required by the detail specification) 26
8.6.6 Equivalent series resistance [ESR] (if required by the detail specification) 27
8.7 Temperature characteristic of capacitance 27
8.7.1 Special preconditioning 27
8.7.2 Measuring conditions 27
8.7.3 Requirements 28
8.8 Shear test 28
8.9 Substrate bending test 28
8.9.1 General 28
8.9.2 Initial measurement 29
8.9.3 Final inspection 29
8.10 Resistance to soldering heat 29
8.10.1 General 29
8.10.2 Special preconditioning 29
8.10.3 Initial measurement 29
8.10.4 Test conditions 29
8.10.5 Recovery 30
8.10.6 Final inspection, measurements and requirements 30
8.11 Solderability 31
8.11.1 General 31
8.11.2 Test conditions 31
8.11.3 Recovery 32
8.11.4 Final inspection, measurements and requirements 32
8.12 Rapid change of temperature 32
8.12.1 General 32
8.12.2 Special preconditioning 32
8.12.3 Initial measurement 32
8.12.4 Number of cycles 32
8.12.5 Recovery 32
8.12.6 Final inspection, measurements and requirements 32
8.13 Climatic sequence 33
8.13.1 General 33
8.13.2 Special preconditioning 33
8.13.3 Initial measurement 33
8.13.4 Dry heat 33
8.13.5 Damp heat, cyclic, Test Db, first cycle 33

AVA Documents
Document Sharing Hub
Full document details: BS EN IEC 60384-22:2019

8.13.6 Cold 33
8.13.7 Damp heat, cyclic, Test Db, remaining cycles 33
8.13.8 Final inspection, measurements and requirements 34
8.14 Damp heat, steady state 34
8.14.1 General 34
8.14.2 Special preconditioning 34
8.14.3 Initial measurement 34
8.14.4 Test conditions 34
8.14.5 Recovery 35
8.14.6 Final inspection, measurements and requirements 35
8.15 Endurance 35
8.15.1 General 35
8.15.2 Special preconditioning 36
8.15.3 Initial measurement 36
8.15.4 Test conditions 36
8.15.5 Recovery 36
8.15.6 Final inspection, measurements and requirements 36
8.16 Robustness of terminations (only for capacitors with strip termination) 37
8.16.1 General 37
8.16.2 Test conditions 37
8.16.3 Final inspection and requirements 37
8.17 Component solvent resistance (if required) 37
8.18 Solvent resistance of the marking (if required) 37
8.19 Accelerated damp heat, steady state (if required) 37
8.19.1 General 37
8.19.2 Initial measurement 37
8.19.3 Conditioning 38
8.19.4 Recovery 38
8.19.5 Final measurements 38
Annex A (normative) Guidance for the specification and coding of dimensions of fixed surface mount multilayer capacitors of ceramic dielectric, Class 2 39
Annex B (informative) Capacitance ageing of fixed capacitors of ceramic dielectric, Class 2 40
B.1 General 40
B.2 Law of capacitance ageing 40
B.3 Capacitance measurements and capacitance tolerance 41
B.4 Special preconditioning (see 8.2) 41
Annex C (informative) Temperature characteristics of capacitance for the reference temperature of 25 °C 42
Annex X (informative) Cross-reference for reference to IEC 60384-22:2011 43
Bibliography 44

Figure 1 – Fault: crack or fissure 22
Figure 2 – Fault: crack or fissure 23
Figure 3 – Separation or delamination 23
Figure 4 – Exposed electrodes 23
Figure 5 – Principal faces 24
Figure 6 – Reflow temperature profile 30

AVA Documents
Document Sharing Hub
Full document details: BS EN IEC 60384-22:2019

Figure A.1 – Dimensions 39

Table 1 – Preferred values of category voltages 12
Table 2 – Preferred tolerances 13
Table 3 – Temperature characteristic of capacitance 13
Table 4 – Fixed sample size test plan for qualification approval – Assessment level EZ 16
Table 5 – Tests schedule for qualification approval 17
Table 6 – Lot-by-lot inspection 21
Table 7 – Periodic test 21
Table 8 – Measuring conditions 24
Table 9 – Tangent of loss angle limits 25
Table 10 – Test voltages 26
Table 11 – Details of measuring conditions 28
Table 12 – Reflow temperature profiles for Sn-Ag-Cu alloy 30
Table 13 – Maximum capacitance change 31
Table 14 – Maximum capacitance change 33
Table 15 – Number of damp heat cycles 34
Table 16 – Final inspection, measurements and requirements 34
Table 17 – Test conditions for damp heat, steady state 35
Table 18 – Final inspection, measurements and requirements 35
Table 19 – Endurance test conditions ($U_C = U_R$) 36
Table 20 – Endurance test conditions ($U_C \neq U_R$) 36
Table 21 – Final inspection, measurements and requirements of endurance test 37
Table 22 – Initial requirements 38
Table 23 – Conditioning 38
Table A.1 – Dimensions 39
Table C.1 – Temperature characteristics of capacitance for the reference temperature of 25 °C 42
Table C.2 – Measuring conditions of temperature characteristic of capacitance for the reference temperature of 25 °C 42
Table X.1 – Reference to IEC 60384-22 for clause/subclause 43
Table X.2 – Reference to IEC 60384-22 for figure/table 43

Documents
Document Sharing Hub
Full document details: BS EN IEC 60384-22:2019

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 22: Sectional specification – Fixed surface mount multilayer capacitors of ceramic dielectric, Class 2

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60384-22 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 2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) revision of the structure in accordance with ISO/IEC Directives, Part 2:2016 (seventh edition) to the extent practicable, and for harmonizing with IEC 60384-21;
b) deletion of the description on the permissible reactive power in 6.2.2 because it is not appropriate for the purposes of this document;
c) the dimensions of 0201M in Annex A have been added.

Documents
Document Sharing Hub
Full document details: BS EN IEC 60384-22:2019

The text of this International Standard is based on the following documents:

FDIS	Report on voting
40/2640/FDIS	40/2652/RVD

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

This document 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 document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

Documents
Document Sharing Hub

Full document details: BS EN IEC 60384-22:2019

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 22: Sectional specification – Fixed surface mount multilayer capacitors of ceramic dielectric, Class 2

1 Scope

This part of IEC 60384 is applicable to fixed unencapsulated surface mount multilayer capacitors of ceramic dielectric, Class 2, for use in electronic equipment. These capacitors have metallized connecting pads or soldering strips and are intended to be mounted on printed boards, or directly onto substrates for hybrid circuits.

Capacitors for electromagnetic interference suppression are not included, but are covered by IEC 60384-14.

The object of this document 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 are of equal or higher performance levels; lower performance levels are not permitted.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Preferred number series for resistors and capacitors*

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

IEC 60068-2-58:2015, *Environmental testing – Part 2-58: Tests – Test Td – Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*
IEC 60068-2-58:2015/AMD1:2017

IEC 60384-1:2016, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 61193-2:2007, *Quality assessment system – Part 2: Selection and use of sampling plans for inspection of electronic components and packages*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60384-1 and the following apply.

AVA Documents Document Sharing Hub

Full document details: BS EN IEC 60384-22:2019

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
surface mount multilayer capacitor
multilayer capacitor whose small dimensions and nature or shape of terminations make it suitable for surface mounting in hybrid circuits and on printed boards

3.2
capacitor of ceramic dielectric, Class 2
capacitor that 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 a non linear change of capacitance over the category temperature range (see Table 3).

3.3
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 3).

3.4
category temperature range
ambient temperature range for which the capacitor has been designed to operate continuously

Note 1 to entry: This is given by the lower and upper category temperature.

3.5
rated temperature
T_R
maximum ambient temperature at which the rated voltage may be continuously applied

3.6
rated voltage
U_R
maximum DC voltage that may be applied continuously to a capacitor at any temperature between the lower category temperature and the rated temperature

Note 1 to entry: The maximum DC voltage is the sum of the DC voltage and peak AC voltage or peak pulse voltage applied to the capacitor.

3.7
category voltage
U_C
maximum voltage that can be applied continuously to a capacitor at its upper category temperature

4 Information to be given in a detail specification

4.1 General

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

Documents
Document Sharing Hub
Full document details: BS EN IEC 60384-22:2019

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 4.2 may be presented in tabular form if more convenient.

The information in 4.2 to 4.5 shall be given in each detail specification and the values quoted should be selected from those given in the appropriate clause of this sectional specification.

4.2 Outline drawing and dimensions

There shall be an illustration of the capacitors as an aid to easy recognition and for comparison of the capacitors with others.

Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be given in the detail specification. All dimensions shall 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, width and height of the body. When necessary, for example when a number of items (sizes and capacitance/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.

4.3 Mounting

The detail specification shall give guidance on methods of mounting for normal use. Mounting for test and measurement purposes (when required) shall be in accordance with 8.4 of this sectional specification.

4.4 Rating and characteristics

4.4.1 General

The ratings and characteristics shall be in accordance with the relevant clauses of this sectional specification, together with 4.4.2, 4.4.3 and 4.4.4.

4.4.2 Nominal capacitance range

See 6.2.4.1.

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, available for example on the IECQ on-line certificate system website www.iecq.org".

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.

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.

AVA Documents Document Sharing Hub

Full document details: BS EN IEC 60384-22:2019