

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Fixed capacitors for use in electronic equipment
Part 22: Sectional specification – Fixed surface mount multilayer capacitors of
ceramic dielectric, Class 2**

**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**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2024 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications provided, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications, symboles graphiques et le glossaire. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 500 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 25 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Fixed capacitors for use in electronic equipment –
Part 22: Sectional specification – Fixed surface mount multilayer capacitors of
ceramic dielectric, Class 2**

**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**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.060.10

ISBN 978-2-8322-8919-8

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
4 Preferred ratings and characteristics	9
4.1 Preferred characteristics	9
4.2 Preferred values of ratings	10
4.2.1 Rated temperature (T_R).....	10
4.2.2 Rated voltage (U_R).....	10
4.2.3 Category voltage (U_C).....	10
4.2.4 Preferred values of nominal capacitance and associated tolerance values.....	10
4.2.5 Temperature characteristic of capacitance.....	11
4.2.6 Dimensions.....	11
5 Test and measurement procedures.....	12
5.1 General.....	12
5.2 Special preconditioning.....	12
5.3 Measuring conditions	12
5.4 Mounting.....	12
5.5 Visual examination and check of dimension.....	12
5.5.1 General	12
5.5.2 Visual examination	12
5.5.3 Requirements	12
5.6 Electrical tests	14
5.6.1 Capacitance	14
5.6.2 Tangent of loss angle (ar δ)	15
5.6.3 Insulation resistance.....	15
5.6.4 Voltage proof	16
5.6.5 Impedance (if required by the detail specification)	17
5.6.6 Equivalent series resistance [ESR] (if required by the detail specification).....	17
5.7 Temperature characteristic of capacitance (reference temperature 20 °C).....	17
5.7.1 Special preconditioning.....	17
5.7.2 Measuring conditions.....	17
5.7.3 Requirements	18
5.8 Shear test.....	18
5.9 Substrate bending test	18
5.9.1 General	18
5.9.2 Initial measurement	19
5.9.3 Final inspection	19
5.10 Resistance to soldering heat.....	19
5.10.1 General	19
5.10.2 Special preconditioning.....	19
5.10.3 Initial measurement	19
5.10.4 Test conditions	19
5.10.5 Recovery	20

5.10.6	Final inspection, measurements and requirements.....	20
5.11	Solderability.....	21
5.11.1	General.....	21
5.11.2	Test conditions.....	21
5.11.3	Recovery.....	22
5.11.4	Final inspection, measurements and requirements.....	22
5.12	Rapid change of temperature.....	22
5.12.1	General.....	22
5.12.2	Special preconditioning.....	22
5.12.3	Initial measurement.....	22
5.12.4	Number of cycles.....	22
5.12.5	Recovery.....	22
5.12.6	Final inspection, measurements and requirements.....	23
5.13	Climatic sequence.....	23
5.13.1	General.....	23
5.13.2	Special preconditioning.....	23
5.13.3	Initial measurement.....	23
5.13.4	Dry heat.....	23
5.13.5	Damp heat, cyclic, Test Db, first cycle.....	23
5.13.6	Cold.....	23
5.13.7	Damp heat, cyclic, Test Db, remaining cycle.....	24
5.13.8	Final inspection, measurements and requirements.....	24
5.14	Damp heat, steady state.....	25
5.14.1	General.....	25
5.14.2	Special preconditioning.....	25
5.14.3	Initial measurement.....	25
5.14.4	Test conditions.....	25
5.14.5	Recovery.....	26
5.14.6	Final inspection, measurements and requirements.....	26
5.15	Endurance.....	27
5.15.1	General.....	27
5.15.2	Special preconditioning.....	27
5.15.3	Initial measurement.....	27
5.15.4	Test conditions.....	27
5.15.5	Recovery.....	28
5.15.6	Final inspection, measurements and requirements.....	28
5.16	Robustness of terminations (only for capacitors with strip termination).....	28
5.16.1	General.....	28
5.16.2	Test conditions.....	28
5.16.3	Final inspection and requirements.....	28
5.17	Component solvent resistance (if required).....	29
5.18	Solvent resistance of the marking (if required).....	29
5.19	Accelerated damp heat, steady state (if required).....	29
5.19.1	General.....	29
5.19.2	Initial measurement.....	29
5.19.3	Conditioning.....	29
5.19.4	Recovery.....	30
5.19.5	Final measurements.....	30
6	Marking.....	30

6.1	General.....	30
6.2	Information for marking	30
6.3	Marking on the body	30
6.4	Requirements for marking	30
6.5	Marking of the packaging	30
6.6	Additional marking	30
7	Information to be given in a detail specification.....	31
7.1	General.....	31
7.2	Outline drawing and dimensions	31
7.3	Mounting.....	31
7.4	Rating and characteristics.....	31
7.4.1	General	31
7.4.2	Nominal capacitance range.....	31
7.4.3	Particular characteristics	32
7.4.4	Soldering.....	32
7.5	Marking.....	32
8	Quality assessment procedures	32
8.1	Primary stage of manufacture	32
8.2	Structurally similar components	32
8.3	Certified records of released lots	32
8.4	Qualification approval	32
8.4.1	General	32
8.4.2	Qualification approval on the basis of the fixed sample size procedures	32
8.4.3	Tests	33
	Annex A (normative) Guidance for the specification and coding of dimensions of fixed surface mount multilayer capacitors of ceramic dielectric, Class 2	38
	Annex B (normative) Capacitance ageing of fixed capacitors of ceramic dielectric, Class 2	39
B.1	General.....	39
B.2	Law of capacitance ageing	39
B.3	Capacitance measurements and capacitance tolerance	40
B.4	Special preconditioning (see 5.2).....	40
	Annex C (normative) Temperature characteristics of capacitance of 25 °C.....	42
	Annex D (normative) Quality conformance inspection	44
D.1	Formation of inspection lots	44
D.1.1	Groups A and B inspection	44
D.1.2	Group C inspection	44
D.2	Test schedule	44
D.3	Delayed delivery	44
D.4	Assessment levels	44
D.5	test schedule for quality conformance inspection	45
	Annex X (informative) Cross-reference for reference to IEC 60384-22:2019.....	51
	Bibliography.....	52
	Figure 1 – Fault: crack or fissure.....	13
	Figure 2 – Fault: crack or fissure.....	13
	Figure 3 – Separation or delamination	13

Figure 4 – Exposed electrodes.....	13
Figure 5 – Principal faces	14
Figure 6 – Reflow temperature profile	20
Figure A.1 – Dimensions.....	38
Table 1 – Preferred values of category voltages	10
Table 2 – Preferred tolerances.....	11
Table 3 – Temperature characteristic of capacitance	11
Table 4 – Measuring conditions	14
Table 5 – Tangent of loss angle limits.....	15
Table 6 – Test voltages.....	16
Table 7 – Details of measuring conditions.....	18
Table 8 – Reflow temperature profiles for Sn-Ag-Cu alloy	20
Table 9 – Maximum capacitance change.....	21
Table 10 – Maximum capacitance change.....	23
Table 11 – Number of damp heat cycles	24
Table 12 – Final inspection, measurements and requirements	25
Table 13 – Test conditions for damp heat, steady state.....	26
Table 14 – Final inspection, measurements and requirements	26
Table 15 – Endurance test conditions ($U_C = U_R$).....	27
Table 16 – Endurance test conditions ($U_C \neq U_R$).....	27
Table 17 – Final inspection, measurements and requirements of endurance test	28
Table 18 – Initial requirements.....	29
Table 19 – Conditioning	29
Table 20 – Fixed sample size test plan for qualification approval Assessment level EZ.....	34
Table 21 – Test schedule for qualification approval.....	35
Table A.1 – Dimensions	38
Table C.1 – Temperature characteristics of capacitance	42
Table C.2 – Preferred values of the temperature characteristic of capacitance with and without a DC voltage applied	43
Table C.3 – Measuring conditions of temperature characteristic of capacitance for the reference temperature 25 °C.....	43
Table D.1 – Lot-by-lot inspection	45
Table D.2 – Periodic test.....	45
Table D.3 – Test schedule for quality conformance inspection (lot by lot).....	46
Table D.4 – Test schedule for quality conformance inspection (Periodic test)	47
Table X.1 – Reference to IEC 60384-22 for clause/subclause	51
Table X.2 – Reference to IEC 60384-22 for figure/table	51

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. For 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 Publications"). 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 far 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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60384-22 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2019. This edition constitutes a technical revision.

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

- a) the document has been completely restructured to comply with the ISO/IEC Directives, Part 2 and to make it more useable; tables, figures and references have been revised accordingly; Annex X contains all cross-references of changes in clause/subclause numbers;

- b) the requirements of reference temperature 25 °C has been added in Table 5, Table 9, Table 10, Table 12, Table 14 and Table 17;
- c) the table of temperature characteristics of capacitance for the reference temperature 25 °C have been added in Table C.1, Table C.2 and Table C.3;
- d) the requirement in 5.5.2 (visual examination) has been repeated in 5.9.3, 5.10.6, 5.11.4, 5.12.6, 5.13.8, 5.14.6 and 5.15.6;
- e) the deflection D in the very robust designs has been added in 5.9.1;
- f) Annex C has been changed informative into normative;
- g) Clause D.5 (Test schedule for quality conformance inspection) has been newly added to withdraw the blank detail specification: IEC 60384-22-1.

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

Draft	Report on voting
40/3120/FDIS	40/3139/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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 specify preferred ratings and characteristics and to select from IEC 60384-1:2021 the appropriate quality assessment procedures, tests and measuring methods and to give general performance requirements for this type of capacitor. Test severities and requirements specified in detail specifications referring to this document provide specific test severities and requirements of an equal or higher performance level. Further information on the conception of generic, sectional and detail specifications can be found in the Introduction of IEC 60384-1:2021.

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 60068-2-58, *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 60384-1:2021, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 61197-2:2007, *Quality assessment system – Part 2: Selection and use of sampling plans for inspection of electronic components and packages*

3 Terms and definitions

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

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

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